



International Centre for Ocean Development
Centre international d'exploitation des océans

Fisheries Research Needs of Small Island Countries

M.P. Shepard

Prepared by M.P. Shepard for the International Centre for Ocean Development (ICOD) as a contribution to "The Study of International Fishery Research", which was undertaken on behalf of the World Bank, United Nations Development Programme, Food and Agriculture Organization, Commission of European Communities, and twelve bilateral agencies, including ICOD.

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PREFACE

This report was compiled by consultant Michael P. Shepard. It was based mainly on recent reviews of research requirements of island states associated with the South Pacific Forum Fisheries Agency (FFA). These reviews were prepared by the consultant with substantial collaboration by Andrew Wright, Research Coordinator of FFA and Semisi Fakahau of Tonga. Coverage of the Caribbean and Western Indian Oceans was based mainly on written material provided by Chris Milley and Denis Leclaire of ICOD. However, Dr. Wayne Hunte, Director of the Bellairs Research Institute at St. James, Barbados, reviewed early drafts of the report and provided assessments of research issues in the Caribbean which have been incorporated. During a short visit to the Seychelles in November 1989, the consultant was provided with useful material on research issues in the Indian Ocean area by Michael J. Saunders of the FAO/UNDP Southwest Indian Ocean Programme (SWIOP). The author is most grateful to the above specialists for their contributions but takes full responsibility for any errors or omissions in the material finally presented.



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CHAPTER 1

INTRODUCTION

PURPOSE

- 1.1. The purpose of this report is to assess the requirements of small island countries for research in support of their fisheries management and development programmes.

BACKGROUND

- 1.2. Stemming from the first Fisheries Development Donor Consultation held in Paris in October 1986,¹ the World Bank, in cooperation with the Food and Agriculture Organization of the United Nations (FAO), launched a study of international fisheries research in April 1989.
- 1.3. The Terms of Reference for the Study,² developed in January 1989 by a Steering Committee composed of representatives of the World Bank, UNDP (United Nations Development Program), CEC (Commission of European Communities) and FAO, called for a two-part comprehensive report to be completed by early 1990. The report will ultimately be considered by a Consultative Group, the core of which will be the participants of the 1986 Paris Donor Consultation.
- 1.4. The study has been sponsored by the organisations that formed the Steering Committee plus 13 individual countries.³ An Advisory Committee of experts was appointed to provide guidance to the Study Team on the design and conduct of the project and, in the later stages, to review and advise on preparation of the final report. The Committee members were chosen on the basis of their "recognized expertise and experience" and acted in their personal capacities.
- 1.5. The Team's Plan called for a fact-finding phase to be completed by the end of October 1989 and an analytical phase culminating in presentation of a draft report to the Steering and Advisory Committees in mid-January 1990, followed by preparation of a final report to be reviewed at a second meeting of donors in early June 1990.⁴
- 1.6. The principal data gathering mechanisms utilised by the Team were a series of multidisciplinary missions to different regions including Africa, South America and Southeast Asia and the convening of workshops that included coverage of management of small-scale fisheries, priorities for aquacultural development, utilisation of small pelagics, and the role of industry in technological transfer.
- 1.7. The May 15-17, 1989 meeting of the Advisory Committee generally approved the Team's Plan but noted that:
- "It was felt that other areas that had been neglected were the research activities and needs of small island states in the Pacific, Indian and Caribbean Oceans. In view of their heavy dependence on fisheries, all opportunities for assessing the requirements of at least one island group should be taken; and,
- "... there was a relatively recent review of the research needs in the Pacific that could be updated.⁵ The prospect of incorporating information from any further studies from the region should also be investigated".⁶
- 1.8. Following up on these expressions of views, in May 1989, the Canadian International Centre for Ocean Development (ICOD) indicated its interest in assisting the World Bank Team to supplement the latter's coverage of research requirements in the small island countries. To this end, in September 1989, the Centre collaborated with the South Pacific Forum Fisheries Agency (FFA) to update the earlier fisheries research needs study in the South Pacific and commissioned the present report.

SCOPE OF THE REPORT

Approach

1.9. The present study is based mainly on reviews of research requirements in the South Pacific area commissioned by FFA with ICOD support.⁷ These reviews assessed the extent to which national and regional research programmes have met the needs of island member countries of the South Pacific Forum in managing and developing their fisheries.

1.10. Ideally, it would have been desirable to carry out similar assessments of research needs in regions other than the South Pacific, particularly in the Caribbean and the Western Indian Ocean. However, time and funding limitations prevented such direct approaches. Coverage of research in the latter areas involved mainly study of available written material. Dr. Wayne Hunte, Director of the Bellairs Research Institute at St. James, Barbados, provided assessments of research issues in the Caribbean which have been incorporated directly into the report. Michael J. Saunders of the FAO/UNDP Southwest Indian Ocean Programme (SWIOP)⁸ provided assessments of research issues in the Indian Ocean area. The author is most grateful to these two specialists for their contributions. The material that has been presented in this report was selected by the author, who takes full responsibility for any errors or omissions.

1.11. The report attempts to:

- Characterise the state of the fisheries resources of small island countries and to describe their utilisation;
- identify problems and opportunities for fisheries management and development;
- identify requirements for research in management and development programmes;
- characterise the extent to which research is now contributing to such programmes; and,
- make suggestions for increasing the effectiveness of research in fisheries management and development programmes.

Relation to the World Bank Study

1.12. The principal objective of the broader World Bank Study, namely to assist developing countries to acquire research knowledge aimed at increasing benefits from the fisheries resources, was kept prominently in mind during preparation of this report.

1.13. In addition, the specific sub-objectives of the Study were taken into account, including:

- Determining the degree to which information lack is a constraint to fisheries development and management;
- determining priority research needs;
- identifying specific research areas appropriate for international support; and,
- preparation of an action plan for such support.

It is noted that the Study is intended not only to identify information gaps but to consider institutional weaknesses as well.

- 1.14. In assessing the Study's objectives, the Advisory Committee added a qualification.⁹

"The identification of research priorities should also highlight those constraints imposed by the dynamics of the socio-economic, cultural and environmental systems in which fisheries development and management are embedded. The different role of fisheries and aquaculture in offshore, coastal and inland waters should be clearly addressed giving due consideration to the increasing complexity of interactions with other sectors passing from the open sea to inland waters."

- 1.15. The foregoing would seem to emphasise the necessity of considering fisheries research within a very broad context rather than focusing on fisheries "for its own sake".

Road Map to the Report

- 1.16. With the foregoing considerations as guidance, the remainder of this chapter outlines the countries under study and characterises their geography and socio-economic status. Chapter 2 describes the aquatic resources and fisheries of the countries and characterises their fisheries management and development problems and opportunities.

- 1.17. Chapter 3 outlines past research and institutional arrangements for the conduct of research related to fisheries management and development. Chapter 4 provides a perspective of future requirements and possible approaches to meeting them. Chapter 5 represents a synthesis, identifying the most important constraints to the development of effective research programmes and making recommendations for bringing about improvements.

THE SMALL ISLAND COUNTRIES

- 1.18. As outlined above, this study focuses mainly on the 14 small island countries and territories of the South Pacific associated with the South Pacific Forum Fisheries Agency (FFA): the Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Solomon Islands, Tokelau, (a dependency of New Zealand receiving support from the Agency), Tonga, Tuvalu, Vanuatu and Western Samoa (Figure 1). The larger Member States of the South Pacific Forum, Australia, New Zealand and Papua New Guinea, were not considered nor were dependent territories of the Metropolitan powers France, the United States and the United Kingdom (e.g., French Polynesia, American Samoa and Pitcairn Island).

- 1.19. Less detailed consideration was given to the small island states associated with the Caribbean Community (CARICOM) and/or the Organization of East Caribbean States (OECS), including Anguilla, Antigua/Barbuda, Bahamas, Barbados, Dominica, Grenada, Jamaica, Montserrat, St. Kitts/Nevis, St. Lucia, St. Vincent and the Grenadines, and Trinidad/Tobago (Figure 2). Dependent territories of France, the United States and the Netherlands (e.g., Martinique, Puerto Rico and the Netherlands Antilles), and dependent islands lying off the coasts of mainland countries such as Venezuela, were not included.

- 1.20. Consideration was also given to the small island states of the Western Indian Ocean associated with the United Nations-sponsored Indian Ocean Fisheries Commission (IOFC), including Comoros, Maldives, Mauritius and the Seychelles (Figure 3). Larger island states (e.g., Madagascar) and dependencies of France (e.g., Réunion) and of mainland countries in the region (e.g., Zanzibar), were not included.

- 1.21. It is recognised that the foregoing groupings of countries do not include all of the small island countries with interests in fisheries. In particular, it would have been appropriate to include inland countries in the South Atlantic such as Cape Verde and São Tomé e Príncipe. However, time limitations and lack of available source material did not permit such coverage. Nevertheless, it is felt that the countries selected provide a broad enough spectrum of resources, fisheries problems and opportunities, and peoples, to permit reasonable generalisations regarding fisheries research requirements in countries with limited land masses and proportionally long coastlines.

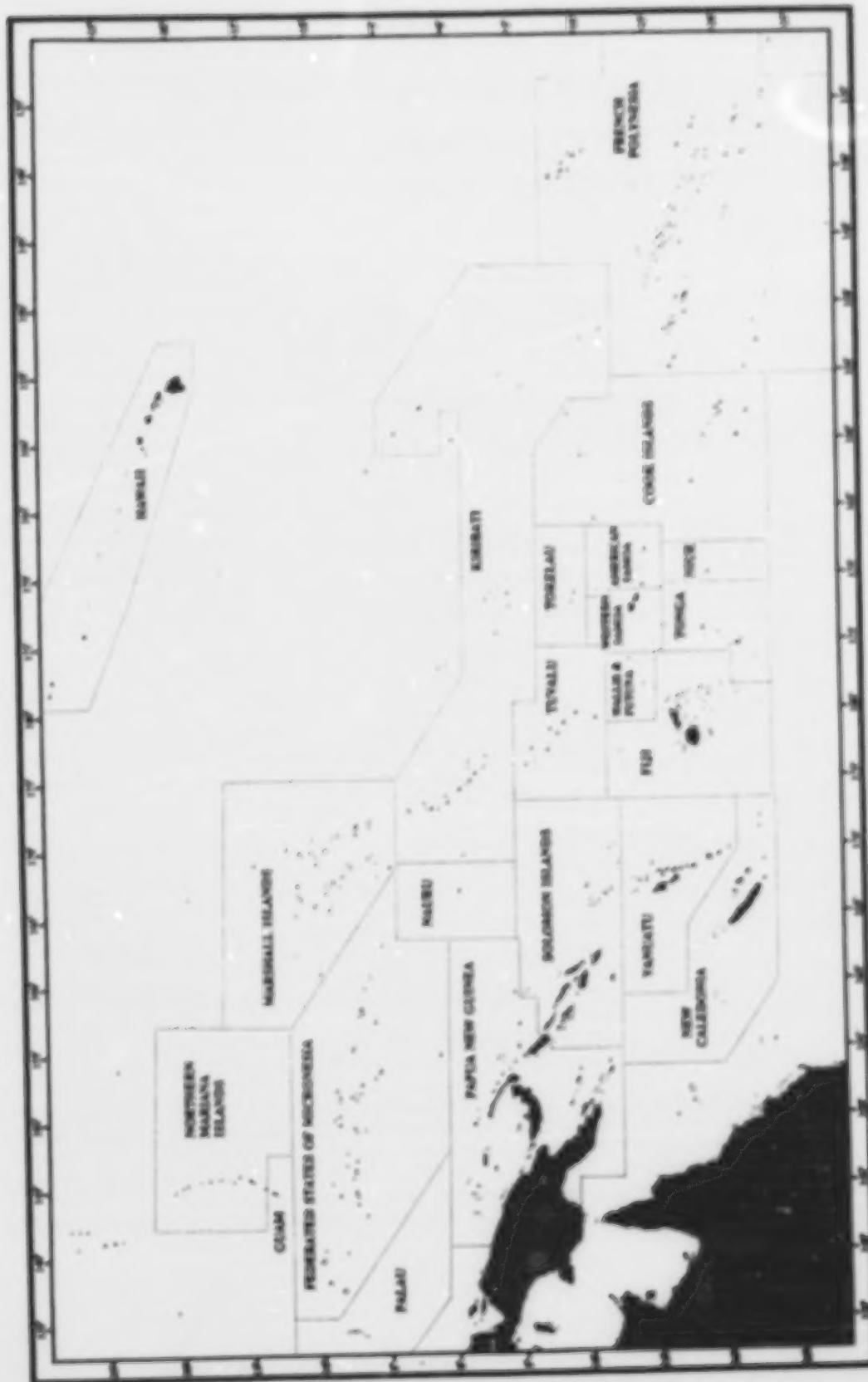


Figure 1.1 Small island countries of the South Pacific.

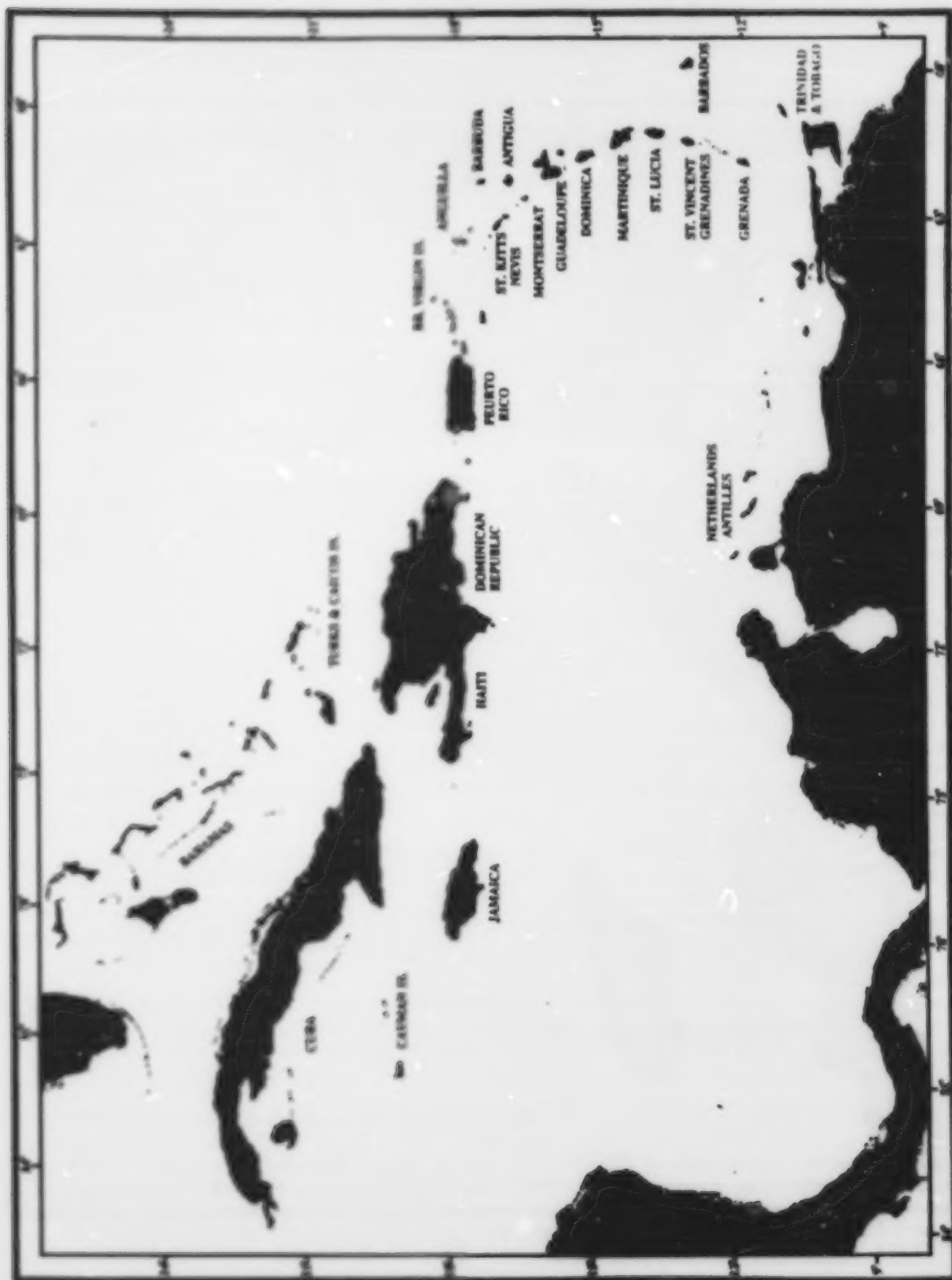


Figure 1.2 Small island countries of the Caribbean.

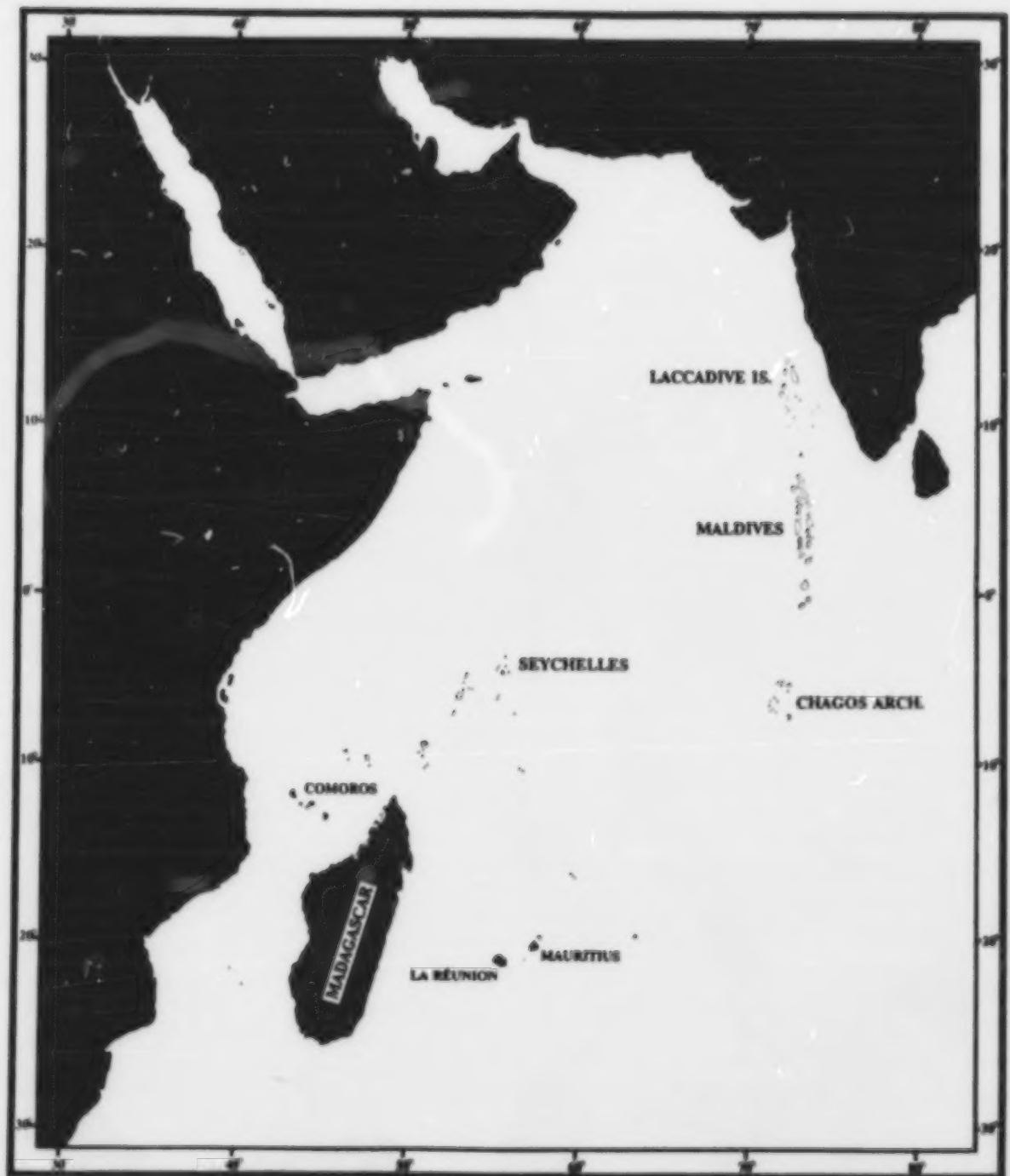


Figure 1.3 Small island countries of the Western Indian Ocean.

Land Masses and Populations

1.22. Table 1.1 lists the 32 states within the 3 regional groupings under consideration.¹⁰ In terms of land mass, the small island countries rank among the smallest in the world. Though none is as small as the Vatican or Monaco, over half (18) are smaller than the European principality of Andorra.

1.23. These small island countries are also minuscule in terms of population. Again comparing them to mini states in Europe, a third (11) of the small island states have smaller populations than Monaco (Table 1.2). Two thirds of the countries have populations of less than 100,000. In the United States alone, there are over 270 cities with populations larger than 100,000. Whereas populations are often small, on a global scale, population density in some states (e.g., Maldives, Barbados, Mauritius and Nauru) is very high (Table 1.3).

Economic and Political Status

1.24. Despite their size, small island states have a potentially powerful voice on the international political scene. For example, of the 32 states under consideration, over half are members of the United Nations, comprising over 10% (18 of 161) of the membership of the organisation (Table 1.2); this despite the fact that the combined population of the 18 (7.4 million) comprises less than 0.2% of the world population of over 4 billion.

1.25. Virtually all 32 small island states being studied are developing countries with active interests in development of their natural resource sectors. Most are former colonies of Metropolitan powers and have achieved their independence in the last quarter century. Some are not yet independent. With a few notable exceptions, almost all are still heavily dependent on external economic and technical assistance for maintenance of their material standards of living and for further economic progress.

1.26. National development plans of most of the countries call for reduction in dependency on such outside assistance; the stated national objectives of almost all the states emphasise the achievement of economic self-reliance (mainly through the development of local industries) as a major goal.

1.27. As shown in Table 1.4, national economic wealth (as reflected in GNP figures) varies greatly between small island countries. All three regions exhibit some countries with moderately high per capita GNPs as well as others with very low economic indexes, reflecting a similar mix of levels as those observed in developing countries on adjacent mainlands or in similar circumstances in other parts of the world. Economic status therefore is not a distinguishing criterion for differentiating small island countries from other developing countries in the world.

1.28. There are some fundamental differences between the cultures of the three regions under consideration. The island states of the Pacific are populated mainly by indigenous peoples (Melanesian, Micronesian and Polynesian) who have occupied the islands for a thousand years or more. In a number of states (particularly in Melanesia), until recently, only very small proportions of the populations have participated in the cash economy. In such societies, traditional patterns of land and coastal zone tenure and resource use have extremely important implications for fisheries management and development.

1.29. In the Caribbean and in a number of states in the Western Indian Ocean,¹¹ populations currently inhabiting the islands have arrived mainly in the last 400 years. Often representing a mix of peoples, traditional cultural patterns do not have as great an influence on resource use patterns and dependence on the cash economy is much more important.

The Importance of the Sea and Its Resources

1.30. Land-based natural resources do not tend to be plentiful in small island countries and, in most, economies are fragile. In the past, agriculture was often the most important industry. Plantation economies were the basis of much early economic development. Weakness in the agricultural sector has brought pressures for diversification. In recent years, tourism has provided spurs to development in a number of small countries.

Table 1.1 Land area of small island countries considered in the present study compared with those of other selected countries

Rank	Island Countries Studied	Other Countries	Area (Sq Km)
1		India	3,146,829
2		Mexico	1,958,201
3		Tanzania	945,037
4		Venezuela	912,050
5		Mozambique	799,380
6		Sri Lanka	655,610
7		Somalia	637,657
8		Madagascar	587,041
9		Kenya	582,600
10		Papua New Guinea	462,840
11		New Zealand	268,046
12		Guyana	214,969
13		Cuba	114,524
14		Dominican Repub.	48,442
15		Belgium	30,518
16		Haiti	27,750
17	Solomon Is.		27,556
18		Belize	22,963
19	Fiji		18,333
20		Hawaii	14,760
21	Vanuatu		14,760
22	Bahamas		13,864
23	Jamaica		11,425
24		Puerto Rico	8,959
25	Trinidad/Tobago		5,124
26	Western Samoa		2,831
27		Luxembourg	2,586
28	Mauritius		2,040
29	Comoros		1,862
30	Dominica		751
31	Tonga		748
32	Kiribati		717
33	FSM		702
34	St. Lucia		617
35	Palau		497
36		Andorra	468
37	Seychelles		455
38	Antigua/Barbuda		442
39	Barbados		430
40	Turks/Caicos		430
41	St. Vincent/		388
42	Grenada		311
43	Maldives		298
44	Cook Islands		293
45	St. Kitts/Nevis		267
46	Cayman Islands		260
47	Niue		258
48	Marshall Is.		181
49		Liechtenstein	160
50	Anguilla		155
51	Montserrat		106
52	Tuvalu		26
53	Nauru		21
54	Tokelau		10
55		Monaco	2
56		Vatican	0.2

Source: The Statesman's Yearbook, 1989-90, 126th Ed. Macmillan Press. London

Table 1.2 Populations of small island countries considered in the present study compared with those of other selected countries.

Rank	Island Countries Studied	Other Countries	Year of Entry to UN	Population	Year
1		India	1945	683,810,051	1981
2		Mexico	1945	82,700,000	1988
3		Tanzania	1961	23,200,000	1987
4		Kenya	1963	22,800,000	1988
5		Venezuela	1955	18,770,000	1988
6		Sri Lanka	1975	16,600,000	1988
7		Mozambique	1960	14,907,000	1988
8		Madagascar	1945	10,920,000	1988
9		Cuba	1945	10,240,000	1986
10		Belgium	1945	9,875,716	1987
11		Dominican Repub.	1945	6,700,000	1987
12		Somalia	1960	6,260,000	1988
13		Haiti	1945	5,722,000	1985
14		Papua New Guinea	1975	3,480,000	1987
15		New Zealand	1945	3,307,084	1986
16		Puerto Rico		3,196,520	1980
17	Jamaica		1962	2,300,000	1987
18	Trinidad/Tobago		1962	1,240,000	1988
19	Mauritius		1968	1,056,867	1987
20		Hawaii		964,691	1980
21		Guyana	1966	812,000	1987
22	Fiji		1970	715,375	1986
23	Comoros		1975	422,500	1987
24		Luxembourg	1945	372,100	1988
25	Solomon Is.		1978	285,796	1986
26	Barbados		1966	253,881	1987
27	Bahamas		1973	236,171	1986
28	Maldives		1965	200,000	1988
29		Belize	1981	176,000	1987
30	Western Samoa		1976	163,000	1986
31	Vanuatu		1981	149,400	1988
32	St. Lucia		1979	146,600	1988
33	St. Vincent/Grenadines		1980	112,614	1987
34	Tonga			95,200	1988
35	Dominica		1978	94,191	1987
36	Grenada		1974	88,000	1985
37	FSM			86,094	1988
38	Antigua/Barbuda		1981	81,500	1986
39	Seychelles		1976	67,000	1988
40	Kiribati			66,250	1987
41		Andorra		51,400	1988
42	St. Kitts/Nevis		1983	43,700	1986
43	Marshall Is.			40,609	1988
44		Leichenstein		27,700	1987
45		Monaco		27,063	1982
46	Cayman Islands			23,700	1988
47	Cook Islands			17,185	1986
48	Palau			14,106	1988
49	Montserrat			11,852	1985
50	Tuvalu			8,229	1985
51	Nauru			8,042	1982
52	Turks/Caicos			7,436	1980
53	Anguilla			6,700	1988
54	Niue			2,531	1986
55	Tokelau			1,690	1986
56		Vatican		1,000	?

Source: The Statesman's Yearbook. 1989-90. 126th Edition. Macmillan Press. London.

Table 1.3 Population per unit land area of small island countries considered in the present study compared with those of other selected countries.

Rank	Island Countries Studied	Other Countries	Population	Land Area (Sq Km)	Popn. per (Sq Km)
1	Maldives		200,000	298	671
2	Barbados		253,881	430	590
3	Mauritius		1,056,867	2,040	518
4	Nauru		8,042	21	378
5		Puerto Rico	3,196,520	8,959	357
6	Tuvalu		8,229	24	343
7		Belgium	9,880,000	30,518	324
8	St. Vincent/Gren.		112,614	388	290
9	Grenada		88,000	311	283
10	Trinidad/Tobago		1,240,000	5,124	242
11	St. Lucia		146,600	617	238
12	Comoros		422,500	1,862	227
13	Marshall Is.		40,609	181	224
14		India	683,810,051	3,166,829	216
15	Jamaica		2,300,000	11,425	201
16	Antigua/Barbuda		81,500	442	184
17	Tokelau		1,690	10	167
18	St. Kitts/Nevis		43,700	267	164
19	Seychelles		67,000	455	147
20		Dominican Repub.	6,700,000	48,442	138
21	Tonga		95,200	748	127
22	Dominica		94,191	751	125
23	FSM		86,094	702	123
24	Montserrat		11,852	106	112
25	Kiribati		66,250	717	92
26	Cayman Islands		23,700	260	91
27		Cuba	10,240,000	114,524	89
28		California	27,662,900	411,015	67
29	Cook Islands		17,185	293	59
30	Western Samoa		163,000	2,831	58
31	Anguilla		6,700	155	43
32		Mexico	82,700,000	1,958,201	42
33		Kenya	22,800,000	582,600	39
34	Fiji		715,375	18,333	39
35	Palau		14,106	497	28
36		Sri Lanka	16,600,000	655,610	25
37		Tanzania	23,200,000	945,037	25
38		Mozambique	14,907,000	799,380	19
39		Madagascar	10,920,000	587,041	19
40	Turks/Caicos		7,436	430	17
41	Bahamas		236,171	13,864	17
42		New Zealand	3,307,084	268,046	12
43	Solomon Is.		285,796	27,556	10
44	Vanuatu		149,400	14,760	10
45		Somalia	6,260,000	637,657	10
46	Niue		2,531	258	10
47		Belize	176,000	22,963	8
48		Papua New Guinea	3,480,000	462,840	8
49		Guyana	812,000	214,969	4

Source: The Statesman's Yearbook. 1989-90. 126th Edition. The Macmillan Press. London.

Table 1.4 Average per capita GNP for small island countries considered in the present study compared with those of other selected countries. Note: Data not available for all small island countries considered in the study.

Rank	Island Countries Studied	Other Countries	GNP per Capita (US\$)	Year
1		United States	16,710	1985
2		Belgium	9,230	1986
3	Nauru		9,091	1985
4	Cayman Islands		9,000	1987
5	Bahamas		7,190	1986
6		New Zealand	7,110	1986
7	Trinidad/Tobago		5,120	1986
8	Barbados		4,668	1987
9	Seychelles		3,590	1988
10	Montserrat		3,127	1985
11		Venezuela	2,930	1986
12		Cuba	2,696	1981
13	Antigua/Barbuda		2,380	1986
14		Mexico	1,850	1986
15	Fiji		1,810	1986
16	Mauritius		1,720	1987
17	St. Kitts/Nevis		1,700	1986
18	St. Lucia		1,320	1986
19	Grenada		1,240	1985
20	Dominica		1,210	1986
21		Belize	1,170	1986
22	Jamaica		1,068	1987
23	St. Vincent/		960	1986
24	Western Samoa		770	1984
25		Dominican Repub.	710	1986
26		Papua New Guinea	690	1986
27	Tonga		580	1986
28	Solomon Is.		530	1986
29		Guyana	500	1986
30	Tuvalu		500	1985
31		Sri Lanka	400	1986
32	Kiribati		390	1985
33	Vanuatu		350	1981
34		Haiti	330	1986
35	Maldives		310	1986
36		Kenya	300	1986
37	Comoros		280	1986
38		Somalia	280	1986
39		India	270	1986
40		Tanzania	240	1986
41		Madagascar	230	1987
42		Mozambique	90	1986

Source: The Statesman's Yearbook, 1989-90, 126th Edition, Macmillan Press, London

Table 1.5 Numbers of tourists visiting small island countries considered in the present study compared with those of other selected countries. Note: Data not available for all small island countries considered in the study.

Rank	Island Countries Studied	Other Countries	Tourist Arrivals	Year	Population	Tourists per capita
1	Cayman Islands		480,792	1987	23,700	20.29
2		Br. Virgin Is.	221,920	1987	13,246	16.75
3		Virgin Is. (US)	1,520,000	1986	110,800	13.72
4	Bahamas		3,002,000	1986	236,171	12.71
5		Hawaii	6,100,000	1988	964,691	6.32
6	Turks/Caicos		36,647	1987	7,436	4.93
7		Guam	407,100	1986	105,979	3.84
8		Florida	35,700,000	1986	12,262,425	2.91
9	Montserrat		28,224	1987	11,852	2.33
10	St. Kitts/Nevis		91,383	1987	43,700	2.09
11	Grenada		171,000	1986	88,000	1.94
12	Antigua/Barbuda		149,000	1986	81,500	1.83
13	Barbados		421,859	1987	253,881	1.66
14	St. Lucia		171,000	1986	146,600	1.17
15	St. Vincent/Gren.		127,776	1987	112,614	1.13
16	Seychelles		71,626	1987	67,000	1.07
17		Fr. Polynesia	161,238	1986	191,400	0.84
18		Martinique	261,139	1987	336,000	0.78
19		Fr. Guiana	66,100	1986	90,500	0.73
20	Maldives		131,399	1987	200,000	0.66
21		Guadeloupe	212,000	1986	336,300	0.63
22		Belize	99,266	1987	176,000	0.56
23	Fiji		389,866	1987	715,375	0.54
24	Tonga		44,677	1987	95,200	0.47
25	Jamaica		1,037,634	1987	2,300,000	0.45
26	Dominica		41,200	1987	94,191	0.44
27		New Caledonia	60,747	1987	153,700	0.40
28	Western Samoa		49,710	1986	163,000	0.30
29		New Zealand	855,492	1987	3,307,084	0.26
30	Mauritius		207,560	1987	1,056,867	0.20
31		Reunion	93,476	1986	574,800	0.16
32	Trinidad/Tobago		182,640	1986	1,240,000	0.15
33		United States	29,700,000	1988	238,700,000	0.12
34	Vanuatu		18,000	1986	149,400	0.12
35		Dominican Repub.	800,000	1986	6,700,000	0.12
36		Mexico	5,407,000	1987	82,700,000	0.07
37	Tuvalu		474	1987	8,229	0.06
38	Solomon Is.		12,555	1987	285,796	0.04
39		Kenya	662,100	1987	22,800,000	0.03
40		Ecuador	252,443	1986	9,640,000	0.03
41		Haiti	112,000	1986	5,722,000	0.02
42		Venezuela	317,300	1986	18,770,000	0.02
43		Sri Lanka	230,000	1986	16,600,000	0.01
44	Comoros		5,000	1986	422,500	0.01
45		Papua New Guinea	32,000	1986	3,480,000	0.01
46		Tanzania	59,000	1985	23,200,000	0.003
47		Madagascar	27,000	1986	10,920,000	0.002
48		India	1,160,000	1987	683,810,051	0.002

Source: The Statesman's Yearbook. 1989-90. 126th Edition. Macmillan Press. London.

This is illustrated in Table 1.5 which provides recent data on tourist visits to the size of indigenous populations. In relation to the numbers of permanent inhabitants in many of the small island states, the numbers of tourist visits are often very high.

1.31. Whereas economic development has tended to be land-based, the seas have always held a special significance for small island countries.

1.32. Comprising small islands or aggregations of islands, the countries under study in the present report have high ratios of coastline to land mass.¹² As shown in Table 1.6, particularly in the South Pacific and Western Indian Oceans where islands are widely scattered, the ratios of sea area to land area are much greater than for most countries.¹³ For most of the smaller countries, populations are concentrated mainly within a few kilometres of the coast.

1.33. The sea therefore physically dominates these island countries. Unfortunately, the inland waters and the inshore and nearshore waters of the oceans do not provide a substantial basis for economic development.

1.34. A significant number of small island states are atolls with severe shortages of water. Others are composed mainly of small land masses of volcanic origin with little flat land and riverine development. Mangrove areas are also very limited. Under such circumstances, with the exception of a few of the larger islands (e.g., Fiji), freshwater and brackish water resources are of little importance in the countries under consideration. For similar reasons, aquaculture has not been of great interest in small island countries.

1.35. Lying in the Tropics (between 10° and 23°S), the ocean waters surrounding the islands are generally unproductive. In most countries, the more productive inner reef and lagoon areas are narrow.

1.36. On a commercial basis, in absolute terms, marine fish production is low. Although statistics are very incomplete, it is likely that the annual total inshore catches of the 32 small island countries would not exceed 150,000 mt, roughly equivalent to the annual catch of Greenland or Australia¹⁴ and only around 0.15% of the estimated recent world catches of around 98,000,000 mt.

1.37. And yet, despite their relative sparseness, inshore and near-shore fisheries resources are of vital importance to the coastal communities of the islands. Although firm data are lacking, it is evident that subsistence consumption of fish in small island countries tends to be higher than in most other countries and fishing is usually an important activity at the village level or as a means of meeting local animal protein demand.

1.38. Even on a commercial basis, and accepting that existing data are of uncertain reliability, in proportional terms, fisheries are important in many of the small island countries. As shown in Table 1.7, per capita commercial fish catches in small island countries (particularly in the South Pacific) are relatively high even exceeding those in vigorous producing countries such as Japan and New Zealand.

1.39. Whereas the inshore areas provide only small harvests, the open ocean waters of the western South Pacific and Western Indian Oceans (significant portions of which lie within 200-mile zones of national jurisdiction of the small island countries) support abundant and valuable resources of migratory tuna. Even in the Caribbean, tuna and tuna-like fish represent one of the most important resources available for exploitation.

1.40. Reflecting the importance of tuna, annual catches of the four major commercial scombrid species in the South Pacific and Western Indian Oceans amount to over 900,000 mt per annum, a significant proportion (almost 40%) of the estimated world tuna catch of about 2,300,000 mt (1986 data). Catches in the Caribbean amount to about 71,000 mt. In all three areas, distant-water fishing fleets of developed countries carry out most of the harvesting of the resource.

1.41. With the foregoing background, the next chapter examines particular fisheries development issues in the three regions.

Table 1.6 Approximate areas of 200-mile zones compared to land areas for small island countries under study contrasted to those of other selected countries. (Note: Data not available for all countries studied)

Rank	Island Countries Studied	Other Countries	Land Area (Sq Km)	EEZ Area (Sq Km)	EEZ Area per Land Area
1	Nauru		21	125,700	5,901.4
2	Tuvalu		24	95,700	3,987.5
3	Marshall Is.		181	591,500	3,268.0
4	Cook Islands		293	638,000	2,177.5
5	FSM		702	872,100	1,242.3
6	Kiribati		717	770,000	1,073.9
7	Maldives		268	279,000	1,041.0
8	Seychelles		455	393,400	864.6
9		Br. Virgin Is.	130	84,050	646.5
10		American Samoa	197	111,500	566.0
11		Northern Marianas	477	218,600	458.3
12		Fr. Polynesia	3,521	1,434,600	407.4
13	Niue		258	102,000	395.3
14	Palau		497	176,800.0	355.5
15	Tonga		748	209,000	279.4
16		Wallis & Futuna	274	73,450	268.1
17	Montserrat		106	21,100	199.1
18	Mauritius		2,040	345,000	169.1
19	Ceyman Islands		260	36,600	140.8
20	Barbados		430	48,800	113.5
21		Guam	541	59,900	110.7
22	Turks/Caicos		430	46,440	108.0
23		Mayotte	373	32,900	88.2
24	St. Kitts/Nevis		267	20,400	76.4
25		Cape Verde	4,033	230,200	57.1
26		Sao Tome/Principe	1,001	49,600	49.6
27	Comoros		1,862	72,600	39.0
28		Reunion	2,512	93,000	37.0
29	Grenada		311	7,700	24.8
30	St. Vincent/Gren.		388	9,500	24.5
31	Fiji		18,333	397,000	21.7
32		New Caledonia	18,576	398,500	21.5
33	Bahamas		13,864	221,400	16.0
34	Vanuatu		14,760	234,400	15.9
35		Guadeloupe	1,705	26,200	15.4
36	Dominica		751	10,200	13.6
37		Martinique	1,079	13,000	12.0
38	Solomon Is.		27,556	325,400	11.8
39	Western Samoa		2,831	28,000	9.9
40	St. Lucia		617	4,700	7.6
41	Jamaica		11,425	86,800	7.6
42		P. Rico + US Virg.	9,311	62,000	6.7
43		New Zealand	268,046	1,409,500	5.3
44	Trinidad/Tobago		5,124	22,400	4.4
45		Haiti	27,750	46,800	1.7
46		Dominican Repub.	48,442	78,400	1.6
47		Papua New Guinea	462,840	690,000	1.5
48		Ecuador	270,670 b	338,000	1.2
49		UK	229,880	274,800	1.2
50		Cuba	114,524	105,800	0.9
51		Madagascar	587,041	376,800	0.6
52		Mexico	1,958,201	831,500	0.4
53		Belize	22,963	9,000	0.4
54		Somalia	637,657	228,300	0.4
55		United States	9,166,759	2,222,000	0.2
56		Sri Lanka	655,610	150,900	0.2
57		Mozambique	799,380	163,900	0.2
58		India	3,166,829	587,600	0.2
59		Venezuela	912,050	134,800	0.1
60		Canada	9,215,430	1,287,000	0.1
61		Tanzania	945,037	65,100	0.1
62		Kenya	582,600	34,400	0.1
63		Belgium	30,518	800	0.03

Source: The Statesman's Yearbook. 1989-90. 126th Edition. Macmillan Press. London

Note: Areas of 200-mile zones are unofficial estimates collated by the author. Their presentation here does not imply an expression of opinion by ICOD concerning the legal status of any country or territory regarding the delimitation of its frontiers or boundaries.

Table 1.7 Estimated catches of marine and freshwater organisms in 1988 in small island countries considered in the present study compared to those of other selected countries.

Rank	Island Countries Studied	Other Countries	Catch (mt)	Population	Catch per cap. (kg)
1	Kiribati		37,725	66,250	569.4
2	Maldives		71,483	200,000	357.4
3	Solomon Is.		54,830	285,796	191.9
4	Turks/Caicos		1,358	7,436	182.6
5	Tuvalu		1,404	8,229	170.6
6		New Zealand	503,265	3,307,084	152.2
7	Jamaica		10,000	94,191	106.2
8		Japan	11,896,935	122,260,000	97.3
9		Ecuador	769,082	9,640,000	79.8
10		Wallis & Futuna	1,000	15,400	64.9
11	Seychelles		4,343	67,000	64.8
12	Cook Islands		1,100	17,185	64.0
13		Canada	1,596,593	25,600,000	62.4
14	Fiji		38,347	715,375	53.6
15		Guyana	41,669	812,000	51.3
16	Barbados		9,097	253,881	35.8
17	St. Kitts/Nevis		1,500	43,700	34.3
18	Antigua/Barbuda		2,400	81,500	29.4
19	Tonga		2,678	95,200	28.1
20		United States	5,965,598	238,700,000	25.0
21		Guadeloupe	8,233	336,300	24.5
22		New Caledonia	3,683	153,700	24.0
23	Grenada		2,001	88,000	22.7
24		Cuba	231,301	10,240,000	22.6
25	Vanuatu		3,249	149,400	21.7
26		Sao Tome/Principe	2,500	115,600	21.6
27	Western Samoa		3,500	163,000	21.5
28		Mexico	1,362,952	82,700,000	16.5
29		UK	917,647	55,780,000	16.5
30		Fr. Polynesia	3,112	191,400	16.3
31	Mauritius		17,154	1,056,867	16.2
32		Venezuela	293,947	18,770,000	15.7
33		Cape Verde	5,372	359,000	15.0
34		Tanzania	340,370	23,200,000	14.7
35	Niue		35	2,531	13.8
36	Comoros		5,500	422,500	13.0
37		Sri Lanka	197,536	16,600,000	11.9
38	Montserrat		111	11,852	9.4
39		Martinique	3,060	336,000	9.1
40		Belize	1,492	176,000	8.5
41		Papua New Guinea	25,554	3,480,000	7.3
42		Madagascar	80,000	10,920,000	7.3
43	Dominica		650	94,191	6.9
44	St. Lucia		945	146,600	6.4
45	St. Vincent/Gren.		712	112,614	6.3
46		Kenya	137,443	22,800,000	6.0
47		Guam	547	105,979	5.2
48		India	3,145,650	683,810,051	4.6
49		Belgium	41,767	9,880,000	4.2
50		Reunion	1,931	574,800	3.4
51		Somalia	18,200	6,260,000	2.9
52		Dominican Repub.	18,800	6,700,000	2.8
53	Trinidad/Tobago		3,200	1,240,000	2.6
54		Mozambique	33,548	14,907,000	2.3
55		Haiti	8,050	5,722,000	1.4
56		Puerto Rico	1,611	3,196,520	0.5

Sources: Population data. The Statesman's Yearbook. 1989-90. 126th Edition. Macmillan Press. London. Catch Statistics. FAO Yearbook. Fishery statistics. Catches and landings. Vol. 66. 1988.

NOTES

1. The consultation, attended by representatives of 29 bilateral and multilateral donor agencies and hosted by the World Bank, was the result of a joint initiative by the World Bank and the Commission of European Communities (CEC). The Consultation was organised by a Steering Committee formed by the World Bank and the CEC joined by the United Nations Development Programme (UNDP), FAO and the African Development Bank. See Study of International Fisheries Research. Report of the First Meeting of the Advisory Committee. May 15-17, 1989. 8 p. and 4 appendices.
2. World Bank Study of International Fisheries Research. Report of the First Meeting of the Advisory Committee. May 15-17, 1989. Attachment 3 of Appendix 2.
3. Donor countries sponsoring the project include Australia, Canada, Denmark, Finland, France, Federal Republic of Germany, Iceland, Italy, the Netherlands, Norway, Sweden, the United Kingdom and the United States.
4. World Bank Study of International Fisheries Research. Report of the First Meeting of the Advisory Committee. May 15-17, 1989. Appendix 3. Assessing fisheries research needs in developing countries. An approach and framework. 21 p. and 4 annexes.
5. Fakahau, S. T. and M.P. Shepard. 1986. Fisheries research needs in the South Pacific. Volume I. Forum Fisheries Agency/International Centre for Ocean Development. Manuscript. 94 p.

Evans, D. 1986. Fisheries research needs in the South Pacific. Volume II. Forum Fisheries Agency/International Centre for Ocean Development. The Federated States of Micronesia, Marshall Islands, Nauru and Palau. Manuscript. 23 p.
6. World Bank Study of International Fisheries Research. Report of the First Meeting of the Advisory Committee. May 15-17, 1989. p. 7.
7. In addition to the two reports referred to in endnote 5, the following two papers were prepared in conjunction with FFA's Tenth Anniversary Conference on Management and Development Strategies in South Pacific Fisheries held in Honiara, Solomon Islands during September 18-27, 1989.

Wright, A. 1989. Current research activities associated with fisheries development in South Pacific Forum countries. Forum Fisheries Agency, FFC 17/TM3/3.2. 49 p.

Shepard, M.P., A. Wright and, S.T. Fakahau. 1989. Reassessment of South Pacific Fisheries Research Needs. Forum Fisheries Agency Report No. 89/91. 22 p.

In addition, Dr. A.D. Lewis of the South Pacific Commission contributed a review paper including perspectives for South Pacific fisheries research in the 1990s:

Lewis, A.D. 1989. A review of achievements in the 1980s and a discussion of priorities for the 1990s. Forum Fisheries Agency. FFC 17/TM3/3.1. 15 p.
8. Regional Project for the Development and Management of Fisheries in the Southwest Indian Ocean. RAF/79/065.
9. World Bank Study of International Fisheries Research. Report of the First Meeting of the Advisory Committee. May 15-17 1989. Appendix 3. Assessing fisheries research needs in developing countries. An approach and framework. P. 2.
10. Unless otherwise stated, data for populations, land areas, GNP and tourism were taken from the 1989-1990 edition of the Statesman's Yearbook. Macmillan Press, London. U.K.

11. With the exception of the Maldives and Comoros.
12. Data on lengths of coastline are not readily available for most small island countries. However, an example of the high ratio is provided by comparing the circumstances of Seychelles and Somalia on the adjacent African coast. Seychelles, with a coastline totalling 600 km and a land mass of about 455 km, exhibits a coastline/land mass ratio of 1.32. On the other hand, nearby Somalia, exhibits a coastline of about 3,025 km, and a land mass of about 636,657 km, giving a coastline/land mass ratio of less than .005. Most continental coastal states exhibit even smaller ratios.
13. Assuming 200-mile zones based on the 1982 Law of the Sea Convention.
14. Catches of all fish other than commercial tuna species, skipjack, yellowfin, bigeye and albacore. See FAO Yearbook for 1986. Fishery statistics and landings. Vol. 62.

CHAPTER 2

THE RESOURCES AND THE FISHERIES

INTRODUCTION

2.1. As background for consideration of research requirements, the present chapter examines the place of fisheries in the small island countries in each of the three regions, including the state of the resources and the management and development of fisheries exploiting them.

THE SOUTH PACIFIC

Subsistence Fisheries

2.2. Approximately 5.1 million people inhabit the island states of the South Pacific Forum (see Table 1.2). About 3.5 million of these live in Papua New Guinea and another one million live in the next two most populous countries, Fiji and Solomon Islands. These three nations possess substantial land masses and expanding urban centres. Their traditions lie mainly with the land and, except in coastal areas, agriculture has always supplied the basic subsistence needs for food.

2.3. The remaining 0.65 million island people of the South Pacific Forum live in 12 small states or territories consisting mainly of chains of scattered islands, many of them barren atolls. In these areas, virtually every villager is by nature a fisherman or a gatherer of sea creatures around the reefs and lagoons. Even in the islands of Melanesia with larger land areas, the coastal communities are heavily dependent on marine resources for their basic subsistence needs. Fish and fisheries have therefore been extremely important elements in traditional island societies and the main source of animal protein for their coastal peoples.

Fisheries Development

2.4. The coming of Europeans and other foreigners to the islands in the 19th Century initially had little impact on traditional use of the marine resources. Although foreigners conducted whaling in many parts of the South Pacific and carried on a small but active trade in beche-de-mer and shells, most foreign-inspired development was associated with agriculture and later with other land based industrial fields such as mining and logging; fisheries apparently did not offer attractive prospects for profitable enterprise. Indeed, there was a small reverse trade involving the import to the South Pacific of salted and dried cod and salmon from North America.

2.5. Prior to World War II, Japanese fisheries developed at various points throughout that country's occupied territories in the South Pacific including the northern Micronesian island groups now comprising Palau, the Federated States of Micronesia and the Marshall Islands, but these developments had little impact on the indigenous peoples. Elsewhere in the South Pacific, colonial administrations paid little heed to fisheries. After World War II, however, greater attention began to be given to the economic and social lot of island peoples.

2.6. The South Pacific Commission (SPC), an advisory and consultative body originally made up of metropolitan powers with interests in the region, was established in 1947 to "encourage and promote the economic and social welfare of Pacific Island People." As early as 1952, the Commission began to carry out work in fisheries, concentrating initially on surveys of the fauna of the region and the development of techniques for harvesting the resources.

2.7. Through the years, the Commission has continued to play a leading role in exploratory fishing and development of appropriate technology for near-shore resources. When the Commission's fisheries programme began, virtually none of the island administrations had officers responsible for fisheries and for many years, the Commission was the only agency actively involved in near-shore fisheries work in the region.

2.8. In the late 1960s and the early 1970s, with plans being laid for virtually all the island territories to achieve independence, the pace of economic life quickened throughout the South Pacific. Increasingly, attention turned to fisheries. With the support of a number of external assistance agencies including FAO, survey activity and assessment of commercial possibilities intensified.

2.9. As part of a world-wide expansion in the tuna industry, locally-based commercial tuna fisheries developed in Papua New Guinea, Solomon Islands, Fiji and Palau, and offshore foreign fisheries intensified their efforts throughout the South Pacific. Other local commercial fisheries developed, some involving small-scale fishermen, but in the main, emphasis was on larger scale operations and relatively little attention was paid to the artisanal fisheries at the village level.

2.10. With this increased interest, a number of territories or newly independent island nations developed small fisheries administrations during the 1960s and early 1970s, technically staffed mainly by expatriates.

2.11. As time passed, with independence and the development of representative parliamentary systems and political accountability, increasing attention began to be paid to needs at the village level and to spreading economic opportunities more broadly throughout countries.

2.12. Development goals, however, were often dualistic, striving for economic development on one hand, while attempting to maintain traditional values on the other. Economic development most commonly involves the creation of income-earning work forces, industrial working routines, and often, movements of population to work sites, activities that are usually incompatible with the maintenance of traditional village life. The challenge was to find the best balance between the somewhat opposing objectives.

2.13. Fisheries, involving the harvest of fish throughout the coastal areas of the countries, appeared to be one of the few activities which would permit both continued participation in village life and participation, to some extent, in the cash economy.

Inshore Fisheries

2.14. As part of the development thrust, by the mid-1970s, increasing attention began to be paid to small-scale fisheries development. The growth of urban centres began to create modest cash market demands, providing outlets for marine products caught by small-scale fishermen.

2.15. Because the reef resources were overexploited in many areas, and in most, fully dedicated to customary subsistence usage, and because many reef fishes are subject to the unpredictable occurrence of ciguatera toxins, the emphasis of village development programmes has been to encourage new fisheries, mainly beyond the reefs.

2.16. Such fisheries harvest previously underexploited bottom fish on the outer slopes of the reefs and pelagic fishes such as tuna, mahi mahi, wahoo and shark in near-shore surface waters. Prosecution of such fisheries has often required the use of larger vessels than those traditionally employed by artisanal fishermen, and the development of more advanced small-scale fishing techniques.

2.17. Because most of the villages are located at some distance from market centres, means for collecting, preserving, holding and transporting products have had to be developed, and in most countries, there has also been a need to establish systems for distributing and selling fish in market centres.

2.18. The general pattern of development has involved:

- Surveys of the resources of the outer reefs, shelf areas and surface waters beyond the reefs, coupled with development of appropriate fishing techniques for their harvest;
- design and construction of suitable vessels capable of fishing safely beyond the reefs;
- training of fishermen in the use of larger vessels and new fishing techniques;

- development of grant and loan arrangements to permit fishermen to acquire the larger vessels, equipment and fishing gear;
- establishment of stores to sell fishermen fishing supplies at cost;
- relief of fishermen from duties and taxes on imported fuel and fishing supplies;
- provision of vessels and equipment repair facilities;
- provision of infrastructure for collecting, preserving and holding fish at the harvesting sites;
- arrangements for transport of products to market; and,
- arrangements for holding and marketing fish in urban centres.

2.19. Progress in the programmes throughout the South Pacific was generally reviewed in documents sponsored by FAO/UNDP, the FFA and ICOD.¹ In the most recent appraisal (1989) it was concluded that the programmes have met with mixed success.

2.20. In most island countries there are now established small-scale fisheries for deep-bottom resources selling high value products to domestic and, in a number of countries, overseas markets. In most cases, harvests are not large, annual catches usually numbering in the tens of tonnes. In some countries, particularly larger countries with broad resource bases, such fisheries have yet to develop on a comprehensive scale. However, on some seamounts and banks, the fisheries have reached the "maturation" phase where catch rates have inevitably dropped from those experienced at the beginning of the fisheries (fishing virgin stocks of large, old fish). In some countries, the economics of fishing in the long term, without the support of grants and low-interest loans, and with lower catch rates and relatively high costs, has slowed the expansion of these fisheries.

2.21. The management challenge is to balance fishing effort against resource availability so that catch rates can provide an economic basis for the continuation of the fishery in the long term. Ways of creating incentives or developing systems at the village level to create economic enterprises that operate in a manner consistent with traditional life styles are needed if fisheries are to develop to their full potential. Long-term demand for high quality fish produced in deep-bottom fisheries provides an encouraging, if limited, economic base for expansion.

2.22. To meet continued demands for small-scale fisheries development, island fisheries administrations have sought new avenues. Currently, technological development of small-scale longlining, particularly for tuna for sale on the Japanese sashimi market, is proceeding rapidly and commercial trials are being planned.

2.23. The reviews concluded that exploitation of inner reef and lagoon resources continues to increase and is of mounting concern to fisheries administrators in many countries. The problems of dealing with overexploitation in the inshore fisheries are discussed in more detail in the next chapter dealing with research needs.

2.24. Statistics of catches and fishing effort in the small-scale fisheries of the South Pacific are woefully inadequate. Based on incomplete data gathered by FAO, recorded catches of aquatic organisms (other than offshore tuna - see below) in the South Pacific countries under consideration amounted to less than 100,000 mt (Table 1.7). Whereas the actual catches would likely be higher than the recorded total, the absolute amounts are nevertheless very small. As pointed out in Chapter 1, the aggregate inshore catch in the South Pacific is substantially smaller than in many developed countries of moderate size.

Large-scale Commercial Fisheries

2.25. From the foregoing, it is evident that the near-shore and inshore resources are not abundant and cannot provide the basis for substantial economic development required to decrease substantially the dependence of island nations on external assistance. If fisheries are to make substantial contributions to the economy of the islands, offshore commercial ventures will be a necessity.

2.26. Fortunately, the waters off the shores of most island states support abundant stocks of tuna and other pelagic fishes which migrate broadly throughout the region. This resource is now fished mainly by the distant-water expeditionary fleets of at least ten foreign countries, the most important of which are Japan, the United States, Taiwan and the Republic of Korea, but in the past 15 years, a number of local island countries have developed their own medium-scale industrial tuna fisheries. Locally-based fisheries account for only a small proportion of the total catch (5.7 and 7.1 percent of the total regional catch in 1987 and 1988 respectively).

2.27. Annual commercial catches of tuna in South Pacific waters currently exceed 600,000 mt. Most tuna is sold on world markets for canning (mainly in the United States) but substantial amounts are sold as frozen or smoke-dried products (mainly in Japan). Most of the catch is composed of skipjack although higher priced tuna species are caught as well.

2.28. The South Pacific currently provides over a quarter of the world tuna catch in terms of weight and over forty percent of the world catch of skipjack. Tuna landed from the South Pacific (including the waters of Papua New Guinea and high seas areas) are now worth about US\$ 500 million per annum, a value almost as great as that of combined exports of all other renewable natural resource products from all South Pacific island countries (around US\$ 640 million in 1980) and rivaling the value of mineral exports (US\$684.0 million in 1980), the region's most valuable commodity.²

2.29. Scientific assessments indicate that present levels of skipjack catch are far lower than could be harvested on a sustainable basis without endangering the stocks. Removals of other stocks are probably closer to levels where fishing may have effects on production. For albacore, the threat posed by large-scale driftnet fishing by Asian fleets is a matter of increasing concern to South Pacific countries.

2.30. Nevertheless, it is evident that overall, the total economic returns from the fishery could be substantially higher. Tuna represents the region's most valuable renewable resource, and, in the long term, probably its most valuable resource overall.

2.31. As mentioned before, the very substantial benefits flowing from the resource now accrue mainly to distant-water fishing nations. The harnessing of this resource for the benefit of island countries represents perhaps their greatest opportunity to achieve economic self-sufficiency. For some, it may represent the only hope of ever approaching this goal.

2.32. The recent changes in the Law of the Sea, granting coastal states sovereign rights for the exploitation of the resources within 200-mile zones, and the fact that the interlocking zones of the island nations cover the great majority of the South Pacific ocean's surface, have provided an excellent opportunity for island states to gain substantial increased benefits from the tuna resources off their shores. In 1979, the Forum countries established the South Pacific Forum Fisheries Agency to provide a focus for harmonisation of fisheries policies and for the development of coordinated avenues to the negotiation of access arrangements between island states and distant-water fishing nations. FFA has been very successful in developing new approaches for cooperation between coastal states and distant-water fishing states utilising the coastal states' 200-mile zones.³

2.33. In recent years, major technological changes have occurred in the industrial fisheries for tuna.⁴

- There has been a major shift to purse seining targeting on yellowfin and skipjack. Whereas in the mid-1970s, the vast majority of the South Pacific tuna catch was taken by pole and line vessels and longliners, over 60 % of the total catch is now taken by seiners; pole and line vessels now take less than 20% of the catch. There are currently about 130 seiners from 10 countries operating in the region. Purse seining continues to increase in effectiveness as vessels have

developed techniques for setting on free-swimming schools instead of just on schools aggregated around logs or in nearshore areas around fish aggregating devices (FADs).

- with catch rates dropping, longliners (from Japan, Korea and Taiwan), targeting mainly on yellowfin and bigeye, have adjusted techniques to fish at greater depths;
- new fisheries for albacore have developed in waters mainly south of 35° S with the arrival in 1987 of driftnetting vessels from Japan, Korea and Taiwan (approximately 160 vessels in total) and the initiation, in 1986, of a United States/Canadian and Fijian hook and line troll fishery.

2.34. Tuna fisheries have been the main target of management by South Pacific countries featuring a series of regionally coordinated bilateral agreements specifying the terms and conditions for foreign-based vessels operating in the region. In 1988, a multilateral Treaty on Fisheries was signed between Forum member countries and the United States. Total annual receipts to island countries in fees and goods and services annually amount to US\$25-30 million, a significant contribution to island economies, and for some small island countries, a substantial proportion of their foreign earnings.

2.35. With continuously improving technology, the intensity of the tuna fisheries is expected to increase.

2.36. In respect of albacore, the South Pacific nations are making concerted efforts to ban existing driftnet fishing in the region because it is viewed as a threat to the well-being of this resource that is targeted for future development by island countries.

2.37. Interactions between fisheries (e.g., possible reductions in abundance of large yellowfin as a consequence of increased harvests of small, surface schooling fish by purse seines) are under active investigation. Allocation of allowable catches between gear types is expected to be an active management issue over the next decade.

Aquaculture

2.38. Although a number of experiments and trials have been conducted, there have been few successful aquaculture ventures in the South Pacific. Seaweed farming in Fiji and Kiribati is showing promise and other countries are in the process of investigating possibilities. Transplants of trochus initiated by the Japanese in the 1920s and 1930s in Micronesia and recently extended throughout the region, have been successful. In the context of integrated coastal planning, mariculture and reef ranching is being viewed increasingly as an alternative source of earnings for small coastal communities.

Summary

2.39. In reviewing the approaches taken to fisheries management and development, the 1984 review report referred to above concluded that, in government planning for fisheries in the South Pacific, there appeared to be three imperatives:

- Preservation of the fragile resources of the reefs and lagoons on which the traditional life styles of coastal communities of most island nations depend;
- modest development of small-scale near-shore fisheries to create employment opportunities at the village level and to supply local urban and export markets;
- development of industrial fisheries (either local or foreign) to increase the benefits accruing to island states from offshore tuna resources.

2.40. The more recent 1986 and 1989 reviews confirm this observation.

THE CARIBBEAN

2.41. Over 30 million people live on the islands of the Caribbean, approximately 4.4 million of them in the 14 states included in the present study. Of the latter population, 3.5 million live in Jamaica and Trinidad and Tobago, and less than a million live in the other 12 countries studied.

2.42. The peoples now inhabiting the islands of the Caribbean came as immigrants as a consequence of the region's long history of colonial occupation. The indigenous populations were either exterminated or absorbed.

2.43. In general, the economies of the small island states under consideration were based mainly on plantation agriculture. Subject to the vagaries of international commodity markets, limited arable land and marginal environmental circumstances, the potential for agriculture as a platform for sustainable development is limited.

2.44. Recently, tourism and light industry have been the focus of developmental activities in the Caribbean, with tourism being of greatest importance in the smallest island states (see Chapter 1). Governments place high priority on the improvement of health care, education and the provision of social services and substantial improvements in these fields have been achieved in recent years.

2.45. The sparse fisheries of the area have been of limited economic and cultural importance. Indeed, fisheries has often been viewed as an occupation of last resort. Although hard facts are scarce in both areas, it would appear that subsistence use of fish in the Caribbean is less than in the traditional societies of the South Pacific.

2.46. However, through local commercial channels (usually involving women fish vendors), fish is an important item in the diet of Caribbean peoples and of growing importance in serving an increasing tourist trade.

2.47. Although there have been many studies of individual fisheries in the region, the very limited prospects for expansion of existing inshore fisheries have resulted in there being few concerted fisheries development programmes among the small island countries being considered. Recent fishery development programmes have focused on offshore pelagics, both in terms of developing more effective local fishing operations (e.g., "ice-boat" fishing for flyingfish in Barbados or preliminary attempts at longlining for oceanic pelagics by a number of countries), as well as on efforts to obtain better returns from access arrangements with foreign fishing fleets operating in the region.

2.48. Governments are anxious to enhance the role of fisheries in national development, in order to:

- Increase employment opportunities;
- reduce, by means of import substitution, extra-regional fisheries imports thereby conserving foreign exchange; and,
- increase the supply of, and access to, affordable protein.

2.49. Fisheries for offshore pelagics, reef fishes, coastal shrimps, continental shelf demersal fishes, deep slope and bank fishes, lobster, and conch are of greatest importance to CARICOM Member States. Of lesser importance is the harvesting of coastal pelagics, sea turtles, sea urchins, whales and porpoises, and seaweeds. The status of the various fisheries is outlined below.

Inshore Resources

Reef and Lagoon Fish

2.50. Trap and line fisheries are conducted on virtually every reef throughout the Caribbean. The species composition of the catch varies among habitats and with the degree of exploitation. In deeper areas, particularly those which have not been badly overexploited, snappers, groupers, and large parrotfishes may contribute significantly to the catch. In inshore areas, particularly where heavily exploited, most of the catch is made up of squirrel-fishes, grunts and surgeon fishes.

2.51. Low catch per trap, small size of fish, and the scarcity of the larger, more valuable species in most countries are considered to be conclusive evidence that reef fish resources are overexploited throughout the region (with the possible exception of the Bahamas).

2.52. The fisheries, prosecuted on a small scale, are of great socio-economic importance in all the small island states. Their importance lies largely in the fact that they offer a low investment employment opportunity where few alternatives exist. In a few areas (e.g., some islands of the Grenadines), fisheries represents essentially the only form of employment.

2.53. Several serious practical problems beset the fisheries. These include theft of traps, the possible deleterious effects of abandoned traps continuing to catch fish ("ghost traps"), the presence of ciguatera poisoning (particularly in the northern Caribbean) and, the deterioration of coastal water quality, particularly in those countries emphasising tourism-related coastal zone development. Licensing and the development of biodegradable panels for traps represent partial solutions to the first two problems.

2.54. There is increasing concern about the status of the inner reef fisheries which pose extremely difficult biological, economic and sociological problems. These problems are discussed in more detail in the next Chapter where their implications for future research are discussed.

Lobster

2.55. Spiny lobster is a high priced resource distributed on island and continental shelves primarily in coral and rocky reef habitats. Lobster are fished by divers and by traps. They are also an important component of the catch in traps set for reef fish. Lobster are not as commercially important in Trinidad as they are in other islands, including Tobago. Most lobster are either exported or sold to hotels and restaurants for tourist consumption. Rough estimates of potential yield from the Lesser Antilles indicate a total export value of US\$ 3.8 million, and a restaurant retail value of about US\$ 14 million.

2.56. Lobster are considered to be fully or overexploited in most CARICOM countries, with areas of severe local depletion close to population centres. Possible exceptions are Anguilla and the Bahamas.

2.57. Young lobster inhabit inshore habitats which are subject to destruction and degradation. Therefore, if diminished recruitment is documented, it will be difficult to distinguish between the effects of overfishing and of juvenile habitat loss or degradation.

Conch

2.58. Conch are distributed in sand and seagrass habitats on island and continental shelves. They are harvested by divers, often with SCUBA. Owing to their high value, most are either exported or sold to hotels and restaurants for tourist consumption.

2.59. Rough estimates of potential yield from the Lesser Antilles indicate a total export value of US\$ 5 million, and a restaurant retail value of about US\$ 40 million. This resource is considered to be fully or over-exploited throughout the CARICOM region with areas of severe local depletion. The Bahamas are a possible exception.

2.60. Young conch inhabit inshore habitats which are subject to destruction and degradation. Therefore, as in the case of lobster, the relative effects of overfishing and of juvenile habitat degradation will be difficult to distinguish.

Nearshore Resources

Deep Slope and Bank Fish

2.61. Deep slope and bank fishes, mainly snappers, groupers and jacks, are harvested with traps and hand lines. The fish command a relatively high price in restaurants and significant quantities are exported.

2.62. Although there are reports of local depletion in the CARICOM region, particularly of known spawning aggregations, there is no reliable information on the state of exploitation of these resources. In some parts of the region there is probably scope for expansion of these fisheries, and thus a need for policy decisions regarding the mix of commercial versus small-scale effort which will be desirable.

2.63. Because there is a limited amount of deep slope and bank habitat in the region, the total abundance of these resources is relatively small. At present, only very rough estimates of sustainable yields are available (based mainly on data from other areas). For example, one estimate for the Lesser Antilles sets the total annual potential in the order of 700 - 800 mt.⁵ On the basis of catch rates by boats fishing in US coastal waters, this yield can be taken with a fleet of about 20 mechanized mid-size (15 m) "snapper" boats, and there are already several new vessels of this size range in the Lesser Antilles targeting the resource with traps and lines.

2.64. It is therefore likely that this resource will be fully exploited, if not over-exploited, within three to five years, and management measures may be required if adverse effects are to be avoided.

Continental Shelf Demersals - Shrimp and Groundfish

2.65. Shrimp support substantial commercial fisheries by large trawlers in Suriname, Guyana and Trinidad, and also small-scale inshore fisheries. These species are typically short lived and use inshore mangrove and estuarine areas for nurseries, moving offshore as they mature.

2.66. Shrimp fisheries in the Guyana-Brazil area began in 1959 and grew to about 19,000 mt by 1968. Although the fleet continued to increase in number, almost doubling from 1968 to 1977, total catches remained relatively stable but catch rates declined substantially (by about half). Reduction in effort following the declaration of 200 mile limits by the coastal states in the 1970s may have been responsible for a subsequent increase in catch rates. The indications are that the fishery has been fully utilizing the resource since the late 1960s, and was overcapitalised in the late 1970s.

2.67. Although all the coastal countries acknowledge the need for control of this fishery, there are no agreements among them to facilitate joint management.

2.68. A 1986 Workshop concluded that there was a great deal of mixing among shrimp stocks in the region and that effective management will require a cooperative effort.⁶

2.69. On the shelf extending from Trinidad to Suriname, snapper communities predominate on the hard-bottom slopes near the shelf edge whereas sciaenids (e.g., sea trout and croakers) are the most abundant demersal species on the soft bottom closer to shore, with catfish predominating in inshore waters.

2.70. Some of these demersal fish are the target of small-scale inshore fisheries, but by far the bulk of the catch is taken as incidental catch in the trawl fisheries for shrimp. It is estimated that approximately 60,000 mt per year are taken in this manner, a major concern to those responsible for the management of the fisheries.

Coastal Pelagics

2.71. Fisheries for coastal pelagics vary considerably in importance among CARICOM Member States, ranging from about 30% of the total national catch in Grenada to less than 1% in Barbados. Although several countries report declining catches of coastal pelagics, neither the extent of the decline, nor the species involved are documented. There is very little information on the distribution or migration of the species involved, mainly jacks, ballahoo, scads, and small scombrids such as bonito. Beach seines are the main gear in these fisheries, although gillnets are sometimes used.

2.72. Fisheries for small herring-like fishes (clupeids) are mainly for bait, using seines and cast nets close inshore. Experts consider that fisheries for coastal pelagics probably have little potential for expansion. However, in some areas, it is likely that the stocks are overexploited and that proper management could result in higher yields.

Oceanic Resources

2.73. Local fisheries for large pelagic fishes (tuna, billfishes, dolphin, wahoo, kingfish and sharks) are limited mainly to trolling by small boats ranging from canoes to launches.

2.74. The tuna and billfish resources probably migrate broadly throughout the western Atlantic area and are fished by the international fleet of longliners, seiners and, to a very limited extent by pole and line vessels, not only in the Caribbean area but also in adjacent waters offshore and to the south. FAO tuna specialist Jacques Marcille estimated that the aggregate yellowfin and skipjack tuna resource in the lesser Antilles and the Eastern Caribbean Sea off Venezuela was about 55,000 mt and that the resource of other tuna and tuna-like fish was about 30,000 mt.⁸ Catches immediately prior to 1985 amounted to about 30,000 mt of yellowfin and skipjack (55% of potential) and about 12,000 mt of the other species (40% of potential). Most of the catch appeared to have been taken off Venezuela, with only about 5,000 mt from the area around the Lesser Antilles. It was concluded that there was significant room for expansion of the fisheries there.

2.75. A swordfish fishery, prosecuted mainly by United States longliners, greatly increased its catch in the Caribbean in the mid-1980s and there is some concern about the effects of the fishery on the swordfish stocks and on the stocks of other oceanic pelagics which are taken as by-catch.

Flyingfish

Except in St. Vincent and the Grenadines, in the southern Lesser Antilles, flyingfish are the target of active small-scale fisheries. The eastern Caribbean countries probably share a common stock, and although the current degree of exploitation (i.e. catch in relation to potential yield) is unknown, there is concern that the observed expansions in the fisheries could cause management problems (e.g., from catches of 1,000-1,500 mt per annum in the early 1970s, catches by Barbados fishermen increased to 3,000-4,000 in the mid-1980s).

Other Species

2.76. Sea turtles, whales and porpoise have been overexploited in all CARICOM countries, and are now relatively rare. Sea urchins have been overexploited in Barbados, and possibly in St. Lucia. They are either not exploited or underexploited in other CARICOM countries. Harvesting of naturally occurring seaweed is carried out in most countries. Techniques for aquacultural production of seaweed are being developed and put into operation, primarily in St. Lucia.

Unutilised Species

2.77. Exploratory fishing in the 1970s led to the conclusion that there were few unexploited resources on which to base any significant commercial fishery expansion. Very recently, the UNDP/NORAD survey with the RV Fridtjof Nansen has repeated the survey over the continental shelf from Trinidad to Suriname, but the results of this survey are not yet available. However, it is believed that focused exploratory fishing may identify some

localised stocks, particularly of invertebrates, which may be profitably exploited. More specifically, there are indications that commercially valuable quantities of deep-water crabs may occur in the region. Exploratory fishing for squid may also prove to be of importance. Most of the squid now used as bait in the rapidly expanding long-line fisheries in the region is imported.

Summary

2.78. In general, fisheries experts feel that the small nearshore resources of the Caribbean are close to being fully utilised; some are clearly overutilised. In the latter case, better performance could undoubtedly be provided through improved management.

2.79. Some potential exists for expansion of fisheries for offshore pelagics (e.g., tuna) but the extent of the potential and the most appropriate way of utilising it has yet to be determined.

2.80. There are probably few unexploited resources in the region on which to base any significant commercial fisheries expansion, but focused exploratory fishing may identify some localised unexploited stocks. Possibilities include deep-water crabs and squids.

2.81. There may also be some application for exploratory fishing in investigating the potential for extending current fishing grounds, e.g. the possibility of exploiting flyingfish in other parts of the Caribbean.

THE WESTERN INDIAN OCEAN

The Small-scale Fisheries

2.82. As in the South Pacific and the Caribbean, the inshore areas around the small island countries of the Western Indian Ocean provide only moderate catches and in most areas, the resources are heavily exploited. Development efforts have been very limited and the fisheries that exist have been developed mainly by private entrepreneurs serving local markets (except in the Maldives where an extensive small-scale tuna fishery operates).

2.83. The FAO/UNDP Southwest Indian Ocean Fisheries Programme (SWIOP) estimates that local commercial catches in Comoros, Mauritius and Seychelles amount to about 7,000, 2,300 and 5,000 mt respectively.⁹ In the Maldives, commercial fish catches other than tuna amount to 5-10,000 mt annually.¹⁰

2.84. Assessments of resource availability and the state of development of the small-scale fisheries are outlined below.¹¹

Comoros

2.85. There have been no resource assessments and hence no estimates of potential yield for the fisheries of Comoros. The continental shelf areas are very small for Grande Comore and Anjouan islands, and relatively large for Mohedi Island. An estimate of the total area from 0-100 m depth is 1,850 km². A rough estimate of the annual catch in recent years is 7,307 mt. The contemporary opinion is that the inshore resources are at or near the level of full exploitation, and that only modest additional catch is likely to result from increasing the fishing effort on the deeper more offshore grounds. Experts from SWIOP feel that the annual potential yield is unlikely to exceed 8,000 mt, having in mind that the present productivity per unit area (about 7 mt/km²) is already very high. It has been suggested that the relatively high productivity is in large part the consequence of tunas being abundant and readily accessible to the artisanal fishermen.

Maldives

2.86. The inshore fisheries of the Maldives are directed mainly toward tuna. The latter fisheries are discussed below in the section dealing with the large-scale commercial fisheries.

Mauritius

Mauritius Island

2.87. The 376 km² of lagoon waters are considered to be heavily fished. The 758 mt catch in 1986 was larger than the estimate of potential yield. The latter was determined from production model analysis as 676 mt. The area of off-lagoon waters to 100 m depth is given as 832 km². The catch from these waters in 1986 was 569 mt, or nearly 180 mt less than the potential yield estimate of 745 mt. The estimate of potential yield obtained from the production model analysis on combined data from the lagoon and sub-lagoon areas is 1,699 mt.

Rodrigues Island

2.88. No resource assessments have been undertaken. The area of the grounds (both lagoon and off-lagoon to 100 m depth) has been determined as 1,688 km². The presence of ciguatera in the flesh of certain species represents a constraint on productivity. On the assumption that the productivity per unit area is the same as for Mauritius Island, an estimate for the potential annual yield is 2,100 mt. The catches in recent years are not known. An outdated estimate for the mid-seventies is 1,900 mt. As the catches are likely to be higher now than previously, the resources are probably at or near full exploitation.

Other Islands and Banks

2.89. The resources on the remote outer banks accessible to fishermen from Mauritius are mostly exploited from motherships equipped with dories. In respect to the banks of the Mascarene Ridge and the Chagos Archipelago the estimated potential yield is 7500 mt for demersal species (mainly the Emperor, *Lethrinus mahsena*) caught by handline. These are exploited by fishermen from Mauritius and Reunion, with the catches in recent years being about 5,600 mt and 450 mt respectively. The major concern is over-exploitation of the resources adjacent to St. Brandon Island and the Saya de Malha and Nazareth Banks. As yet there is no active management plan for the fishery. The number of Mauritian vessels has been increasing in recent years and is beginning to cause concern to the commercial companies involved.

Seychelles

Handline species

2.90. Fish taken by handlines are mainly medium to large demersal and pelagic species, exploited primarily on the Mahe Plateau and to a much lesser extent on the Amirantes Plateau. In respect to the Mahe Plateau, the estimates of potential yield are 1,000-1,300 mt from the 6,000 km² of inshore grounds (0-35 m depth), 1,000-1,600 mt from 6,500 km² of offshore banks (36-100 m depth), and 2,200-2,400 mt from the 14,000 km² of trawlable grounds (36-100 m). Catches from the inshore grounds and offshore banks during 1986 were 1,240 mt and 441 mt respectively.

2.91. The resources on the trawlable grounds are largely underfished due to the densities being too low to support handline fishing and the prohibition on trawling (in part due to ecological considerations). On the basis of the above values, the potential increase in catches, if trawling continues to be prohibited, is about 1,000 mt.

2.92. The Amirantes Plateau has 1,200 km² of grounds (0-100 m depth) suitable for handline fishing. A very preliminary value for the potential yield is 400 mt. This is some 200-300 mt more than catches in recent years.

2.93. A rough estimate of suitable but unexploited fishing areas adjacent to the more distant islands is 2,200 km². Assuming the same productivity per unit area as on the Amirantes Plateau, estimated potential yield for this area would be more than 700 mt.

Trap species

2.94. Fish taken by traps are mainly medium sized demersal species presently caught in the inshore waters around the three main islands of Mahe, Praslin and La Digue. The area of these grounds is given as 577 km² (0-35 m depth). They are considered to be fully exploited at the present level of catch (570 mt in 1986).

2.95. The total area of suitable grounds, including the offshore banks of the Mahe Plateau, the Amirantes Plateau and elsewhere, is given as 2,000 km². Assuming the same productivity per unit area as in the presently exploited grounds, estimated potential yield for this area would be 2,000 mt.

Inshore small pelagics

2.96. Inshore catches of small pelagics (mainly Indian mackerel and big eye scad) around the main islands of Mahe, Praslin and La Digue are highly variable, ranging from 200 to 300 mt in recent years. The nearshore area exploited by the seine and mesh net fishermen is given as 200 km². The potential yield from the artisanal fishery is unknown but generally considered to average not more than 500 mt.

Large-scale Commercial Fisheries

2.97. From the foregoing, it is evident that the near-shore resources of the small island states of the Western Indian Ocean provide little opportunity for commercial fisheries expansion. As in the South Pacific, however, abundant resources of migratory tuna provide a major potential for future development.

2.98. In recent years, the Western Indian Ocean has provided about 12% of the world's tuna catch (about 272,000 mt in 1986).¹¹

2.99. The most important traditional local fishery for tuna occurs in the Maldives. Originally fished mainly from local sailing vessels (*dhoni*), since the mid-1970s, the fishery has become increasingly mechanised. It nevertheless continues to be mainly a day-boat fishery operating in near-shore waters. About 22,000 fishermen (of a total population of about 200,000) participate in the fishery, which in the mid-1980s landed about 40,000 mt of tuna annually. The tuna are used both locally for food and for export.

2.100. Tuna represents the country's largest export. "Maldivian fish" (a dried, salted and smoked product) shipped mainly to Sri Lanka, was formerly the dominant export product, but in recent years frozen fish for canning has become more important. Expansion of the fishery is a major element in government planning.¹²

2.101. Elsewhere in the Western Indian Ocean, deep longline fishing by Japan and Taiwan (and later the Republic of Korea) began in the 1950s. Over the years the Indian ocean longline catches have levelled off at about 100,000 mt.

2.102. Major development of the Western Indian Ocean tuna fishery began in 1979 with exploratory purse-seine fishing by vessels chartered by the government of Mauritius during 1979-82. On the basis of such exploratory work, French purse-seine vessels launched a full-scale commercial fishery in 1983-1985. Since then, the fleet (mainly vessels from France and Spain) has expanded to over 50. Catch rates in the fisheries have remained relatively high.

2.103. For the past two years, negotiations have been underway to form a multilateral tuna management body for tuna in the Indian Ocean, but a convention has yet to be concluded.

2.104. Substantial portions of the catches by foreign fleets are made within the 200-mile zones of Western Indian Ocean coastal states and access fees paid by them are providing substantial revenues to some of the countries. Seychelles, in particular, has extensive arrangements with the foreign fleets; the port of Victoria on Mahe Island is the major regional transshipment depot.

2.105. Ninety percent of the catch is transhipped to foreign markets. However, Mauritius, Seychelles and the Maldives all have small canneries.¹²

CONCLUSION

2.106. Situated in tropical seas, and with generally narrow fringing reefs and limited water run-offs and coastal vegetation, fisheries resources available to inshore fishermen of small island states are meagre.

2.107. Nevertheless, especially in the South Pacific and in the Maldives, the inshore fisheries provide the main source of animal protein for traditional societies.

2.108. In small island countries where the cash economy is better developed, fish is very popular. In these areas per capita consumption of fish is substantially higher than in most other countries and fisheries provide employment opportunities at the village level where few other alternatives exist.

2.109. In general, however, fisheries tends to be a low status occupation and is sometimes viewed as an occupation of last resort. Incomes are low and in most areas, without management to balance participation with opportunities, prospects for improvement are dim.

2.110. Inshore resources are commonly overfished from both the biological and economic points of view. Thus, they offer little prospect for further substantial development. It is becoming increasingly apparent that improvements in the fisheries will require active management by fisheries authorities to tailor harvesting power to the capacity of the resources.

2.111. In all three regions, but particularly in the South Pacific and the Western Indian Oceans, the resources of the open ocean, mainly tuna, provide the greatest opportunities for expansion. Currently fished mainly by distant-water fleets of more developed countries, the resources provide some benefits through the provision of fees, and goods and services by the expeditionary fishermen in return for access to 200-mile zones. In some countries, further benefits are provided through the provision of services to the foreign fleets (e.g., transhipping) or through the operation of onshore processing plants utilising foreign catches.

2.112. A few small island countries possess shore-based industries and their own fishing fleets. Development of such locally-based industries remains a goal of a number of other small island countries.

2.113. Tuna are often seasonally available in near-shore waters. Development of appropriate technology could well lead to the expansion of small-scale fisheries for presently underexploited pelagic resources.

2.114. Although there is considerable interest in enhancement of reef resources (shellfish), there has been little interest in aquaculture *per se* in any of the three regions considered. With small land masses, shortages of water and lack of mangrove and riverine areas, opportunities are limited. It must be said, however, that the potential for aquaculture in small island countries has not been thoroughly explored.

2.115. From the foregoing it is concluded that fisheries management authorities in small island countries are faced with two basic general requirements in order to ensure the orderly management and development of their fisheries in the future. These are programmes to:

- Protect inshore resources and to rationalise limited near-shore fisheries to improve their economic performance;
- develop local capabilities to carry out biological, technological and economic assessments of the fisheries for offshore pelagics in order to maximise returns from foreign fishing or to develop local industries.

NOTES

1. Shepard, M.P. and L.G. Clark. 1984. South Pacific Development Assistance needs. FAO/UNDP MS. 91 p. and 22 Appendices.

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3. For example see:

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4. Lewis, A.D. 1989. Scientific data on tuna and billfish in the South Pacific Region and their use in fisheries resource management policy. Document prepared for the Workshop on Marine Resources Policy Development and Management for the Pacific Islands Region. East-West Center, Honolulu. 11 p.
5. Mahon, R. 1989. Fishery management options for the Lesser Antilles. FAO/TCP/RLA/6776 Field Doc. 4. 117 p.
6. Erhardt, N.M. 1986. The biological and economic modelling of shrimp resources on the Guyana-Brazil Shelf. Summary Report of the Workshop. Univ. Miami, Florida. 48 p.
7. A few locally based longline vessels have begun to operate very recently.
8. Marcille, J. 1985. Tuna resources of the Lesser Antilles. FAO Fisheries Circular No. 787. 33 p.
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11. For Comoros, Mauritius and Seychelles see reference in Note 12. For Maldives, see:

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CHAPTER 3

PAST RESEARCH

INTRODUCTION

3.1. For purposes of this report, the term research has been given a very practical definition, namely, the collection and investigation of facts required to facilitate fisheries management and development.

3.2. In general, fisheries (and information gathering associated therewith), tend to progress through three general stages, exploration, consolidation, and maturation.

3.3. Often, during the exploratory phase, activities tend to be of a trial and error nature rather than "scientific" and data collection and documentation tends to be inadequate. The consolidation stage occurs as commercial fisheries begin to effect the resources and competition between harvesters becomes a concern. At this stage, there are often calls for "management" and demands are placed on scientists to assess the state of the resource. It is then that concepts regarding resource utilisation tend to be developed.

3.4. At this point, consideration is given to management approaches, including:

- Designation of maximum or optimum sustained yields;
- designation of appropriate levels of effort;
- development of systems for allocating fishing opportunities; and,
- elaboration of legal systems to implement technical decisions.

3.5. The maturation stage is reached when policies and regulatory programmes have been developed and investigative functions involve mainly monitoring.

3.6. With the foregoing as background, the development of past programmes of research in each of the three regions under study will be considered.

THE SOUTH PACIFIC

3.7. The following analysis of patterns of South Pacific fisheries research were drawn mainly from reports by Fukahara, Shepard and Evans prepared for FFA and ICOD in 1986. In the remainder of the present report, the latter works will be referred to as "the 1986 reports". An updating report prepared by Shepard, Wright and Fukahara in 1989 was also used.¹

Historic Development

3.8. Information supporting fisheries management and development in the South Pacific comes from diverse sources. First of all, the traditional experience of the indigenous populations of the islands provided the basic discoveries which led to the development of present day small-scale fisheries and wisdom regarding conservation of the resources. Regrettably, with the introduction of modern technology and changing social values, such knowledge, with a few notable exceptions, is rapidly being lost.

3.9. In the 18th Century, European voyages of exploration provided accounts of the fauna encountered in the South Pacific. In the 19th Century, activities of whaling vessels and of traders collecting sandalwood and beche-de-mer, revealed the existence of highly marketable resources around the islands.

3.10. Later, European colonization was accompanied by desultory (often academic) interest in the marine resources. The major impetus to exploration of the resources came in the 1930s with the expansion of Japanese

commercial tuna fisheries into South Pacific waters. After World War II, the Japanese fleets, followed later by fleets from Taiwan, the Republic of Korea and the United States, spread throughout most of the South Pacific.

3.11. In the main, excellent records were kept of these exploratory activities. The South Pacific Commission, formed in 1947, began fisheries investigations in the early 1950s. During 1954-1961, the SPC fisheries programme was instrumental in the establishment of government fisheries services in Fiji, the Caroline Islands, Guam, Western Samoa and American Samoa. Since that time, SPC has been the most active regional focus for biological and fisheries technological work in support of South Pacific fisheries development.

3.12. Successive FAO/UNDP South Pacific Regional Fisheries Development Programmes have played active roles supporting South Pacific fisheries research activities, mainly through the channelling of funds and the facilitation of consultancy services and training.

3.13. In the larger South Pacific countries, particularly in Papua New Guinea and Fiji, independent biological research programmes have been conducted for many years. Most of the other FFA countries are now developing some biological research capability. A number of regional and overseas institutions have also contributed to biological work in the South Pacific. These include the Institute of Marine Resources (IMR) of the University of the South Pacific (USP); the French overseas research and technical organisations, Office de la Recherche Scientifique et Technique Outre-mer (ORSTOM) and L'Institut Français pour l'Exploitation de la Mer (IFREMER, formerly CNEXO); the International Center for Living Aquatic Resources Management (ICLARM); and the Queensland Department of Primary Industries.

3.14. Collection of information through such programmes has been associated mainly with the "exploratory" phases of the fisheries, concentrating on the identification of resources and the development of technology for their exploitation.

3.15. Extension of fisheries jurisdictions by island states in 1978, involving negotiations with distant-water fishing nations regarding fishing rights, switched attention to disciplines other than biology and fisheries technology. The South Pacific Forum Fisheries Agency, formed in 1979, became the focus for economic and legal investigations in support of regional fisheries management and development. Through the continuing Regional Research and Development Programme, the Agency conducts research on economics of fish marketing; industrial tuna development (markets, processing and fishing); surveillance methodology and practice; legal aspects of international and domestic fisheries management and enforcement; boundary delimitation; and the structuring of cooperative international fisheries arrangements. The Agency has recently added a biological research coordinator to its staff.

Inshore Resources

Reef and Lagoon Resources

3.16. In general, as noted in the 1986 review reports, overexploitation of reef resources has been a common concern among fisheries administrators throughout the South Pacific. Because of their long-standing heavy utilisation, the inshore resources have not been viewed as an important focus for expanded fisheries development and therefore have frequently not been subjected to direct study.² Few island countries have even established basic monitoring programmes to measure the harvests of inner reef resources. Thus, although overexploitation of reef resources has repeatedly been identified as a serious problem, that problem remains essentially unstudied and undocumented.

3.17. In speculating on the reasons inshore fisheries had received such little research attention, the authors of the 1986 report concluded that few administrations had been able to clearly identify the nature and amount of information that should be collected to pinpoint the problems and to provide background for finding possible solutions.

3.18. Whereas on a global scale, there is a substantial body of biological data and some development of theoretical concepts of management, there have been few carefully planned programmes of resource assessment coupled with the application of remedial measures to restore the health of the depleted inner reef stocks.

3.19. Thus, at the present time, there is no firm body of evidence that managers can invoke when planning and justifying proposed managerial actions; there are no ready scientific blueprints for island fisheries administrators to follow in collecting information, in making assessments, and in charting courses for improving management.

3.20. The reviewers observed that most island country fisheries officers consider that the extremely difficult administrative, social and political problems posed by attempts to bring the largely traditional subsistence fisheries under significant controls make the task impossible. Remedial measures might be attempted if the proposed action could be clearly specified; if its consequences could be predicted with considerable accuracy; and if it had a high likelihood of bringing about visible improvements in a short time.

3.21. Unfortunately, information on which to base such actions is not available. Under these circumstances, the officers can see little value in expenditures of scarce funds and the deployment of scarce technical manpower on what is viewed as a lost cause.

3.22. Instead, administrations have tended to look to the development of new fisheries as the best means of meeting the problems of providing increased supplies of food, expanding employment opportunities, and preserving the inner reef resources. Such developments, however, sometimes add to the problems; advanced artisanal vessels and gear designed to participate in new fisheries often turn to traditional resources when the catch rates on their intended targets drop or when weather prevents fishing on the new grounds. Similar problems have beset small-scale fisheries around the world.

3.23. The reviewers listed deficiencies in present approaches to information collection on the inshore fisheries.

- Lack of statistics. Very few island countries operate systems of catch statistics which can measure changes in total production, in catch rates and in species composition of the inshore fisheries. With outside advice, a number of countries have attempted to establish such systems. Almost all have failed; sometimes because proposed procedures have been too complex or expensive or in other cases, because the routine collection of information has been given a very low priority by fisheries administrations whose attention is focused upon active development of non-traditional fisheries outside the reefs.
- Lack of clear-cut alternatives for management of the fisheries. As outlined above, there are no tried and true blueprints for action on inshore fisheries that would convince decision makers and fishing interests that such efforts were worthwhile.
- Lack of programme emphasis on inshore small-scale fisheries. Lack of such alternatives creates a vicious circle; because remedial actions are so difficult, there is no incentive to devote effort to the problems, and because the problems are not addressed, they worsen.

3.24. To bring about improvements in the situation, the 1986 reports proposed that a Working Group of island fisheries experts be formed to develop cooperative approaches, exchange information and obtain effective external technical assistance to meet the growing problems.

3.25. The review reports noted that regional organisations were not placing emphasis on research requirements for management of inshore fisheries (both the inner reef fisheries and the near-shore fisheries discussed in the next section of this report) and recommended that SPC strengthen its work in this field.

3.26. Although governments have not responded to the proposal to form a Working Group of experts, there have been promising developments towards increasing the capabilities of regional organisations to assist countries to meet their inshore fisheries problems. In 1988, SPC formed an Inshore Fisheries Research Project with two research specialists whose job is to assist governments to develop research in the inshore fisheries field.

3.27. In its first year, the Project convened a major workshop dealing with inshore resources which was invaluable in initiating regional dialogue regarding research and in commissioning the collection of an immense amount of information on Pacific islands marine resources and their fisheries that probably could not have been assembled in any other way.

3.28. There have been other measures to strengthen the effectiveness of regional organisations in assisting island countries to plan and implement research on the inshore and near-shore fisheries. In 1988, FFA established a Research Co-ordination Unit in Honiara, its principal interest being the small-scale fisheries. The Australian Centre for Agricultural Research (ACIAR) and ORSTOM are actively involved in field work related to inshore fisheries and the Australian Institute of Marine Science (AIMS) and James Cook University have also become active on a limited basis.

3.29. Substantial bilateral efforts (particularly involving USAID) have increased the availability of computers throughout the region which, with appropriate training (e.g. an ICOD-sponsored workshop at USP in early 1989), has enhanced the analytical capabilities of island research staff to collate data useful for stock assessment. There has also been some progress on making information on stock assessment methodologies available and comprehensible to island researchers (eg., the July 1989 Deepwater Snapper Stock Assessment Workshop in Honolulu, the above-mentioned July 1988 SPC Workshop on Pacific Inshore Fishery Resources, the December, the 1988 FFA ELEFAN Workshop and several papers including those by Munro and Fikahau² and by King and McIlgorm⁴).

3.30. However, in most countries, stock assessment work remains largely undeveloped and further training and "learning by use" will be required before such work can provide an effective basis for improving management and development programmes. Thus, whereas it is evident that some progress has been made in enhancing regional capabilities for training and technical assistance, the results, in terms of improvements in provision of information to facilitate development and management programmes, are not yet in evidence. Perhaps it is too early to tell.

3.31. One area in which there has been significant progress has been the collection of information as a basis for management of growing fisheries for inshore invertebrates such as beche-de-mer, green snails and trochus. For trochus, market prices have increased almost 300 percent in the last six years, resulting in a major increase in harvesting efforts. A number of island countries are now attempting to limit harvesting to ensure maximum long-term sustainable yields. As background for management, national fisheries agencies in the Cook Islands, Federated States of Micronesia, New Caledonia and Fiji conduct field surveys prior to trochus harvest seasons. Commonly, on the basis of such surveys, harvests are set at 30-40 percent of the standing stock. Interest in trochus has led to expansion of work to develop methods for introducing stocks to areas where trochus did not exist before.

3.32. For other sedentary resources supporting significant fisheries such as beche-de-mer, little effort has been expended on research in support of fishery management. In Fiji, however, where exploitation has increased greatly in recent years, assessments have been made which have led to the imposition of stringent management measures including harvest controls and registration of beche-de-mer exporters (as a prerequisite to the issue of an export licence for the product). Other countries supporting beche-de-mer fisheries have yet to introduce management programmes despite the fact that, in many cases, severe depletions have occurred.

3.33. Pearl shell fisheries have operated in the Cook Islands (as well as in Papua New Guinea and French Polynesia) for more than 100 years. The Cook Islands is now promoting expansion of its industry, including the conduct of research to provide biological and fishery information. Future plans include the establishment of a research facility on one of the northern group islands.

Nearshore Resources

Demersal Resources

3.34. As outlined above, with inner reef resources providing little prospect for small-scale fisheries expansion, island fisheries administrations turned to resources that had been little exploited in the past. Prime

targets have been deep bottom fish, particularly snappers and groupers that frequent the seamounts and outer slopes of reefs at depths exceeding 100 m. Because of technological difficulties, these species had been beyond the reach of traditional fishermen. The search for underutilised species also turned to the abundant pelagic resources (mainly tuna) which had been fished by traditional fisheries in a number of island countries. In some areas (e.g., Tokelau), these species formed the bulk of subsistence harvests.

3.35. In respect of exploration, prior to World War II, fisheries for deep bottom resources had been well developed in the Orient. After the war a number of trials were made in the South Pacific (starting in American Samoa). Over the next twenty years this preliminary work led to active exploration and development programmes. The work has focused on the SPC and associated FAO/UNDP-supported fishery programmes.

3.36. During the past decade, SPC's activities have involved a team of several masterfishermen, each working in a separate area. The Project provided the services of the masterfishermen and all fishing equipment while the host governments provided vessels, supplies and counterpart participation.

3.37. The objectives of the Project were to investigate the deep bottom fish resources of outer reef slopes, seamounts and offshore banks; to demonstrate and provide practical training in deep bottom dropline fishing techniques using wooden handreels; and to determine the economic suitability of this type of fishing in each location. The Project has been very successful; it determined that, although the economics of the operations varied from place to place, viable operations were possible in most locations. In several areas, before the Project began its work, islanders had not even been aware that the resource existed. Today, virtually every country associated with SPC has adopted the technologies introduced by the SPC programmes.

3.38. Few regional fisheries development programmes have been as well organised or as well conducted, and with as favourable a response from fishermen as the SPC Deep Sea Fisheries Development Project (and predecessor projects under SPC and FAO/UNDP). Positive elements in the projects and subsequent national follow-ups have included:

- Well planned exploratory activity and appropriate technological development carried out cooperatively between technical specialists and local counterparts;
- initiation of well planned national development programmes involving the design and selection of appropriate vessels and gear; facilitation of participation of fishermen through vessel and gear acquisition schemes; support for transport and marketing of products; and training;
- development of an awareness of the vulnerability of the resources reflected in cautious approaches to setting of catch/effort targets.

3.39. Recently the SPC programmes have been moving towards testing of longline gear for near shore pelagics.

3.40. As outlined in the preceding chapter, fisheries for deep bottom fish are reaching the maturation stage in a number of countries and governments are faced with decisions on whether or not to curtail further development or to apply restrictions on existing fisheries. Routine measurements of the magnitude of catches and of fishing effort are required to make appropriate assessments.

3.41. Because most deep bottom fishing in the South Pacific has developed through government-supported programmes, often using government-owned boats, fisheries divisions have been in a good position to collect valuable statistical information on the new fisheries as they have developed.

3.42. Despite this fact, keeping of catch records has generally not been carried out with vigour and discipline and the collation and analysis of the data collected is usually inadequate and tardy. Shortage of skilled staff is a major factor leading to these deficiencies. More and more, countries are turning to regional organisations for help.

3.43. From the beginning of commercial explorations for deep bottom fishes in the South Pacific, administrators in a number of island countries have expressed concerns about the vulnerability of the resources to fishing. Although the SPC projects provided much useful information for development, the work was not designed to provide the type of information that would permit assessment of the effects of fishing on the resources. Administrators therefore pressed for the collection of independent information on the likely levels of maximum sustainable yields (to use as background for establishing targets for their development programmes).

3.44. There are many fundamental biological questions underlying the management of fisheries for snappers and groupers. Research interest in the species has increased in recent years and there have been a number of useful papers prepared and workshops held, contributing to an improvement in the conceptual basis for development of outer reef slope fisheries. The Workshops include a 1985 Workshop on Management of Deep Bottom Fish; the comprehensive 1989 Workshop on Pacific Inshore Fisheries Resources convened by SPC; a 1985 Technical Workshop on the Biology and Fisheries Management of Snappers and Groupers; and a 1989 Deepwater Snapper Stock Assessment Workshop, the latter two convened by the United States National Marine Fisheries Service. Thus, a progressively firmer basis for the collection and interpretation of information on the exploitation of deep bottom fisheries resources is being laid.

3.45. As noted in the 1986 review reports, there have been continuing demands on the part of national fisheries administrators for clearly defined approaches for economical and simple techniques to measure the potential of their resources and the effects of fishing upon them and "hard" figures regarding MSYs or optimum levels of effort. The reports also noted that regional approaches to providing such information were weak and, in the view of administrators, the responses of regional bodies to meeting these needs had not been adequate.

3.46. In response to such needs, the SPC Inshore Fisheries Research Project and FFA Research Co-ordination Unit described in the preceding section of this report were established to assist countries to strengthen their research capabilities. Whereas these advances are encouraging, both groups have only recently been formed and it is still too early to determine how effective the approaches will be.

3.47. As will be discussed in more detail in the next chapter, despite the recently strengthened capabilities of regional organisations to provide support, the ability of individual countries to plan and implement action programmes to collect, analyse and utilise the results of research on deep bottom fish remains limited. The problem appears to focus on inadequacies in the ability of countries to absorb available technical knowledge.

Nearshore Pelagics

3.48. Trolling for nearshore large pelagic fishes such as skipjack and yellowfin tuna, mahi mahi, Spanish mackerel, etc. is a traditional method of fishing in Polynesia. In the past decade the use of fish aggregation devices (FADs) has greatly increased the practice and it has spread throughout the South Pacific. Most governments have launched programmes to instal and maintain FADs for use by small-scale fishermen (often those that also fish for deep bottom fish). There has been little research associated with these developments.

3.49. SPC has recently been conducting trials of deep longlining around FADs to catch larger tuna for sale in the Japanese sashimi market. Commercial trials are now being carried out in Tonga.

3.50. Whereas small-scale commercial fishing for nearshore pelagics is widespread, operation of the fisheries and the deployment of FADs is often haphazard. FADs are expensive to instal and subject to frequent loss or damage; the relation between costs and returns are rarely considered.

3.51. Although careful records have been maintained in some countries (e.g. off Efate Island in Vanuatu), in most, there is little information collected that would permit analyses of the economic effectiveness of the operations. Essentially, the fisheries for nearshore pelagics are still in the exploratory stage, particularly from the technological point of view, and there are few concerns about the resource and the need for management.

Oceanic Resources

Biological Aspects

- 3.52. As outlined earlier, the abundant offshore pelagic resources of the South Pacific (mainly tuna) support important small-scale fisheries around many of the islands, and major industrial fisheries, mostly prosecuted by distant-water fishing nations.
- 3.53. Beginning in the early 1900s, the development of the industrial fisheries, mainly by Japan, was accompanied by extensive and usually well-documented exploratory fishing.
- 3.54. It is beyond the scope of the present general review to document the voluminous literature on these exploratory tuna fishing operations. In brief, by the mid-1970s, extensive exploratory activity by Japanese fleets had revealed the South Pacific to be the area with the greatest concentration of skipjack tuna in the world. By that time operations of Japanese, Taiwanese and Korean longline vessels had also traced the distribution of deep swimming yellowfin, albacore, bigeye and bluefin throughout the area. Purse seining, which increased in intensity in the late 1970s and into the 1980s, added information on the distribution of surface swimming yellowfin tuna.
- 3.55. As will be discussed in more detail in the next section, in the mid-1970s, SPC launched a Skipjack Survey and Assessment Programme that added substantially to information on the distribution and abundance of skipjack throughout the South Pacific, particularly in areas of the eastern portions of Oceania that had not been covered by the operations of commercial fleets.
- 3.56. Exploration of the commercial availability of tuna throughout the South Pacific was accompanied by efforts to develop more effective fishing technologies. In the late 1970s and 1980s, an important feature of these efforts was the use of FADs to aggregate tunas. This increased the availability of oceanic pelagic fishes to locally-based small-scale fisheries. SPC's small-scale fisheries projects have been in the forefront of work in this field.
- 3.57. Although there is much work still to be done on assessment of the availability of tuna resources in some areas of the South Pacific, it is evident that by the end of the 1970s, with the exception of the introduction of technology (e.g., purse seining), the exploratory phase of the South Pacific tuna fisheries was drawing to a close.

Development of Concepts

- 3.58. In the early 1970s, interest in the development of tuna fisheries was reaching a high point; local tuna industries had been established in a number of island countries and distant-water fishing activities continued to expand. Concern began to be expressed about the ability of the tuna resources to withstand steadily increasing fishing pressure and, looking to precedents elsewhere (e.g., in the eastern tropical Pacific), questions arose regarding the desirability of developing cooperative international arrangements for study and possibly for management of the tuna fisheries of the region.
- 3.59. In the background, spurred by events elsewhere in the world, there was talk of fundamental changes in the Law of the Sea which would extend the jurisdiction of coastal states far beyond existing 3 or 12-mile territorial sea limits.
- 3.60. Beginning in 1973, SPC responded to these regional concerns by initiating the planning of a region-wide skipjack resource assessment programme which was finally launched in August 1977 with the objectives to provide:
- A better understanding of the migrations and stock structure of skipjack, thus determining the degree to which fisheries in different areas exploit the same stocks, and hence interact with each other;

- information on the general distribution and availability of skipjack and baitfish as the basis for further development and management of these resources within the region;
- better knowledge of population parameters (growth, mortality, etc.) of each skipjack stock, thus enabling better assessment of the current status of these stocks and of the effects of fishing on them.

3.61. As a result of the Programme, the South Pacific tuna fishery had clearly passed from the exploratory phase into the second phase - an active search for concepts on which to base future management and development. The programme quickly demonstrated complicated patterns of migration of skipjack and the existence of a very large biomass and rapid turnover within the skipjack population.

3.62. This alleviated immediate fears about possible overfishing of the skipjack resource and resulted in a focus for the development of management measures for the tuna fisheries concentrating on economic and political issues. Thus, as discussed briefly in the next section, the development of management concepts has not dwelt on biological aspects. Nevertheless, there have been substantial regional efforts to monitor the fisheries, and potential problem areas have been revealed. These included possible interactions between purse seine and longline fisheries for yellowfin tuna and the effects of driftnetting on albacore stocks.

3.63. The SPC Skipjack Programme was concluded in 1981. Since then, however, SPC has continued its tuna research activities, concentrating its efforts on:

- Collection and evaluation of fisheries data and maintenance of a regional oceanic fisheries assessment data base;
- assessment of interaction between fisheries for oceanic species;
- assessment and monitoring of the levels of exploitation of stocks of commercially important tuna and billfish species;
- studies of the biology and ecology of commercially important tuna, billfish and bait species;
- provision of fisheries observers and advice on development of observer programmes;
- monitoring the use of fish aggregating devices.
- provision of assistance to countries in the implementation of appropriate systems to monitor artisanal and subsistence fisheries; and,
- provision of assistance to countries in training fisheries biologists in various aspects of quantitative fisheries methods.

3.64. In 1989, a new large-scale tagging programme aimed mainly at determining possible interactions between fisheries for yellowfin has been initiated.

Monitoring

3.65. Because the basic exploration of the South Pacific tuna resource was conducted by highly developed industrial fisheries, monitoring of catch and effort has been extensive from the very beginning. Such information has been used for:

- Biological assessments of the state of the stocks and the effects of fishing upon them;
- assessments of resource potentials as a guide to local tuna development; and

assessments of the magnitude and distribution of foreign fishing as the basis for development of bilateral and multilateral access arrangements for foreign fleets fishing within 200-mile zones of the island states.

3.66. As discussed briefly in the previous section, SPC has been assigned the task of assembling tuna catch and effort data on behalf of FFA Member States. The information includes catch and effort data on local fisheries provided by FFA countries; data provided by distant-water fishing fleets to FFA states under terms of access agreements; and some information provided directly to SPC by the American Tunaboat Association. In addition, SPC collects information on tuna operations conducted in non-FFA/SPC territories (e.g., French Polynesia, New Caledonia and American Samoa).

3.67. Under the control of their own governments, most distant-water fleets maintain comprehensive records of their operations. Until the late 1970s, many of these records were freely available, often in published form.

3.68. Since island governments extended their fisheries jurisdictions to 200 miles in the late 1970s, however, distant-water fishing nations have been reluctant to provide records of their activities for fear of prejudicing their positions in the negotiation of access agreements. As a result, available data on tuna catches, fishing effort, size and species composition of the fish caught, etc., are incomplete. Because information on the distant-water fisheries is provided under terms of access agreements, it does not cover all distant-water catches. For example, catches made in waters beyond the 200-mile limits of coastal states or in zones of states which have not negotiated access agreements may not be included. The latter unrecorded catches account for a substantial portion of the total. Accuracy of catch data provided under access agreements in the past has been questioned.

3.69. FFA member countries, working bilaterally and through FFA, have expended major efforts to improve the quality and quantity of data provided by distant-water fishing nations. The conclusion of a multilateral Fisheries Treaty between the United States and FFA Member States in 1987, represents an important step in this process. Formation of an SPC expert advisory committee including representatives of distant-water fishing countries is also bringing about improvements.

3.70. Data from locally-based industrial operations is quite complete. However, as countries launch experimental operations (e.g., purse seining by one or two boats), requirements for commercial confidentiality may limit the detail of information received.

3.71. Information on catches of oceanic pelagics in small-scale fisheries (particularly new fisheries conducted around FADs), has the same shortcomings as information collected on other small-scale fisheries and basically must be considered inadequate.

Evaluation

3.72. Research work on the region's most abundant and valuable resource, tuna, is carried out almost entirely by international organisations (SPC and FFA) or by outside consultants. Few island Governments have technical officers (biologists or economists) dedicated to investigative work related to the tuna fisheries. Thus, highly trained technical staff, almost all expatriates, are carrying out investigations quite separately from the information users, the island administrators, who in general have little technical background in tuna fisheries.

3.73. This does not mean that island administrations are not deeply involved in tuna issues; in fact, at the administrative and decision-making levels, the islands are well endowed with capable, well-trained people. Nevertheless, island administrations have delegated essentially all technical tuna investigations to outsiders.

3.74. In commenting on this situation, the 1986 review reports noted that there was "... too great a gap between the technical capabilities and interests of the professional staffs of regional organisations and the capabilities and interests of their clients, the island fisheries administrations." To overcome this problem, the report encouraged SPC to recruit islanders to its staff and urged island governments to upgrade the capabilities of their staffs dealing with the tuna fisheries.

3.75. Since 1986, SPC has formed a Standing Committee on Tuna and Billfish, including representatives of island governments, to advise the Commission on its tuna programme. This has substantially improved communication. Also, a reorganisation of the SPC fisheries programme has resulted in the tuna project including more cooperative work with island fisheries officers.

3.76. The Programme plans call for in-country tagging projects which should greatly improve consultation and cooperation between island fishery officers and SPC; expand the capacities of island fisheries administrations to carry out research; and enable them to participate in international discussions of research on tuna.

3.77. Some progress has been made in recruiting islanders to the SPC tuna programme, with three island specialists now on staff. Little progress has been made, however, in developing greater capacities within island fisheries administrations to make their own technical appraisals of the results of SPC's research.

3.78. The 1986 reports also recommended formation of a technical working group on tuna research to assist countries to better articulate their tuna research requirements, particularly in respect of small-scale fisheries development. No action has been taken in this regard, but as pointed out above, the formation of SPC's Standing Committee has increased communication in this field.

Economic and Legal Aspects of the Tuna Fisheries

3.79. Aside from biological studies, there has been a great volume of research activity related to the economics of tuna industries and to legal and institutional arrangements for the conduct of tuna fishing. In the late 1960s and early 1970s, establishment of locally-based tuna industries in several island countries or territories (e.g., Solomon Islands, Papua New Guinea and Fiji), generated a substantial number of consultancy studies and much advice from international assistance agencies. These efforts are difficult to document since many of the original reports were confidential.

3.80. The major development of economic research came in the early 1980s when island states, co-ordinating their activities through FFA, required in-depth information on the economics of foreign tuna fishing, processing and marketing, as background for the levying of access fees under terms of bilateral agreements. In response, FFA, working with island administrations, established information gathering procedures and analytical approaches to relate volumes of foreign catches, economics of vessel operations and market prices as background for the negotiation of access fees. Over the past 6 years, this research has been of great benefit to member countries in assisting them to achieve fair returns from foreign fishing of resources in their zones.

3.81. Increasingly, island countries have been examining potentials for expanding their own locally-based tuna industries. In response, FFA has commissioned a number of studies dealing with the economics of different types of fleets and operating conditions.

3.82. FFA officers have conducted extensive legal research as background for assisting member countries to develop bilateral agreements with distant-water fishing nations and for the framing of domestic fisheries legislation to meet local needs and to provide national legal frameworks for international arrangements. For example, the development of the successful regional register of fishing vessels to facilitate control of foreign fishing vessel activities involved substantial investigative effort and harmonisation of legal instruments within the region.

3.83. The development of local tuna industries remains a very active issue. Local fisheries (national and joint venture) currently catch only about 10% of the South Pacific total, and involve only about 2% of the total capital invested in fishing and processing operations in the region. Island countries are seeking ways of increasing the benefits they derive from the tuna resources and a number are considering initiating new enterprises or expanding existing ones. Although information on resource potentials is important for such considerations, economic analyses are of more immediate concern. Information is required, particularly as background for making national decisions regarding size and type of vessels required, fleet sizes, deployment patterns and marketing arrangements.

3.84. Information requirements include:

- Assessments of the best size of vessel and type of operations for purse seining on local fishing grounds;
- an evaluation of the extent to which small-scale fisheries can be developed to supply tuna for industrial processing;
- assessments of the future viability of pole and line skipjack operations; and,
- an evaluation of the prospects of developing local albacore ventures.

3.85. Obtaining reliable information and dependable advice on such technical issues is very difficult. Most of the experience and technological skills in industrial development involving tuna are the preserve of distant-water fishing industries who quite naturally are reluctant to encourage competitive development by island countries.

Communication

3.86. Through the years, a persistent problem in the South Pacific fisheries community has been communication; calls for better dissemination of information have been a feature of SPC Technical Meetings on Fisheries since the 1960s. Countries are widely separated and their staffs are small. Transportation in most places remains inadequate and day to day communications tend to be quite unreliable. Travel is expensive and because of infrequent flights, even the shortest overseas meeting requires an inordinate expenditure of time.

3.87. Under these circumstances, fisheries officers in virtually every country and in every regional organisation have identified difficulties in keeping abreast of development and research activities in other countries as one of the most serious problems in their work.

3.88. There were many stories of "re-invention of the wheel" because investigators were not familiar with work done elsewhere. Duplication occurs even within countries; records of past activities are generally poor (often due to rapid turnover in personnel), with the result that staff coming on post are often not aware of what has been done by their predecessors. One incident was cited where a certain type of exploratory fishing had been attempted three times in one place (unsuccessfully) with the final two attempts being conducted in complete ignorance of the earlier operations.

3.89. The 1986 review reports concluded that: "... one of the main constraints to the effective development of information in support of management and development was lack of communication."

3.90. The report made four recommendations to overcome this deficiency. These were to:

- i) Give strong support to the University of the South Pacific (USP) Pacific Information Centre (PIC) to assemble, classify and make available for retrieval by island fisheries personnel, all relevant South Pacific fisheries literature;
- ii) provide technical assistance to island fisheries administrations to identify, catalogue and copy available fisheries information in their countries for inclusion in the PIC system;
- iii) provide for technical specialists to review available information to identify material of particular relevance to current island fisheries management and development programmes; and,
- iv) form regional technical working groups of island specialists dealing with specific subject areas to facilitate exchanges of information, development of programmes and acquisition of technical advice.

3.91. In the past three years, there have been vigorous initiatives in the communications field which lead to the report's recommendations in this field having been largely met. These include:

- The establishment of the Pacific Islands Marine Resources Information System (PIMRIS) focused in a Coordination Unit at the USP library and involving cooperation between all South Pacific institutions involved with the sea, including SPC, FFA, USP and CCOP/SOPAC;
- the preparation of an excellent set of national fisheries bibliographies by the FAO/UNDP Regional Fisheries Support Programme;
- the appointment of a Fisheries Information Officer to the Inshore Fisheries Research Project (IFRP) at SPC who is responsible for the production of the SPC Fisheries Newsletter, developing cooperation with PIMRIS and, consistent with Recommendation iv above, planning the establishment of special interest groups (SIGs) to serve as information and communication networks for researchers with common interests. FFA has also recently appointed an Information Officer;
- SPC's establishment of a quarterly Regional Tuna Bulletin, FFA's production of its News Digest and the formal creation of ICLARM's Coastal Aquaculture Network.

3.92. The concept proposed in the 1986 reports, involving island specialists forming their own special interest groups (supported by regional organisations) that meet regularly, has not yet been put into practice. However, the needs for consultation have been met in part by a number of specialist workshops and plans or proposals exist for forming focal groups (e.g., beche-de-mer and pearl shells) that would involve specialists maintaining regular contact. The convening of two albacore workshops and the likelihood that more will be held are, in part, performing the envisaged consultative function for that species.

3.93. From the foregoing, it is obvious that substantial progress has been made in improving communications among island personnel, and between them and regional and international organisations. A matter of some disappointment, however, is the fact that efforts in the communications field are still largely centred on the efforts of expatriates. It must also be noted that documentation of work at the national level, essential if information exchange is to be effective, remains inadequate.

Training

3.94. The development of fisheries administrations (including research staffs) in most South Pacific countries is very new; most have been created within the last fifteen years. Almost all the administrations are very small and only a few have officers whose sole responsibility is research.

3.95. Until recently, most specialised research officers have been expatriates. Very few nationals are qualified fisheries scientists; most of those involved in information gathering for the fisheries are technicians holding diplomas or certificates in general fisheries studies, or individuals holding non-specialised B.Sc. degrees. Very few have had actual experience in fisheries research.

3.96. Most governments recognise lack of trained staff as a severe constraint to the effective development of fisheries management and development programmes. They therefore accord development of qualified local staff, including research officers, a high priority in their planning.

3.97. A decade ago, there was relatively little training in fisheries readily available to inland governments. Since then, there has been a proliferation of regional and bilateral training programmes from the practical field level through to post-graduate training in Universities. Significant training elements within the region include:

- Many specialised workshops ranging from instruction of fishermen in fishing techniques, training in refrigeration and fish handling, etc. to training in biological subjects as mentioned in the preceding chapter. SPC has been the focus for much of this training which commonly

receives funding support from bilateral donors or from the FAO/UNDP Regional Fishery Support Programme;

- longer term specialised fisheries training, particularly for fisheries officers at the Nelson Polytechnic Institute in New Zealand and at the Australian Maritime College;
- diplomate training at the Institute of Marine Resources (IMR) of the University of the South Pacific (USP);
- academic training within the region at USP and at the University of Papua New Guinea (UPNG), including the FFA-directed Ocean Resource Management Programme (ORMP) offering 200 and 300 level courses at USP⁶ and in-service short courses offered on a rotating basis around the region;
- academic training in tropical fisheries, including that offered at two Australian institutions, James Cook University and at the Australian Maritime College.

3.98. In the field of training, it is likely that the South Pacific is more plentifully endowed than most developing areas in the world. However, there appear to be systematic problems in making such training effective.

3.99. Many islanders have availed themselves of these opportunities, but the approach to training has often been quite haphazard. As a result, despite their training, many islanders still lack capabilities for the specific duties they are required to perform.

Academic Research

3.100. The two Universities within the region, the University of the South Pacific and the University of Papua New Guinea, have provided basic non-specialised academic training. In the 1970s, USP, through its Institute of Marine Resources, aspired to develop a centre for research and consultancy services to assist island countries in the fisheries field. Some research work was initiated but little has been done in recent years.

3.101. The 1986 review reports called upon universities in the region to undertake original research work on the population dynamics of inshore resources. Regrettably, since 1986, with a few exceptions (e.g. co-operation between ICLARM's Coastal Aquaculture Centre in Solomon Islands and USP), it would appear that efforts in this direction have decreased rather than increased.

3.102. It is encouraging to note, however, that USP is now recruiting a Professor of Marine Studies whose main duties will be to strengthen USP's capabilities in the marine field. In addition, IMR's activities have recently been subject to an external review which, it is understood, proposes a restructuring and strengthening. It would be hoped that these initiatives will lead to an increasing contribution by USP to the region's fisheries programmes.

Traditional Use Patterns

3.103. The 1986 reports recommended that, as background for management of subsistence fisheries, information on traditional use patterns be assembled. This has partially been addressed through the SPREP programme which has convened a workshop on the subject. With the assistance of external advisors, one or two South Pacific countries have carried out their own studies in this field.

Funding and Direct Technical Assistance in Countries

3.104. The trend of supporting national research programmes from external sources is increasing throughout the region. Three years ago, when research attracted approximately 20 percent of the recurrent allocation to national fisheries agencies, support for research from external sources was equivalent to between five and ten percent of national allocations.

3.105. In 1989, FFA circulated a questionnaire to national fisheries agencies to determine the level of support for research in the region from external sources. All countries responding to the survey identified a trend of increased support for national research programmes from external sources to the extent that throughout the region, external sources of funds are providing up to 50 percent of the financial resources allocated to fisheries research.

3.106. In addition, national fisheries agencies are collaborating more frequently with external research groups to conduct research not supported from national budgets. To a large extent giant clam research and mariculture development throughout the region is supported in this way. The development of research concerning the deepwater snapper and grouper handline fisheries has also received substantial support from external sources. In these cases the adaption of the results of research programmes conducted by external research bodies to situations in the South Pacific has received increased emphasis in recent years.

3.107. The foregoing coverage of South Pacific research programmes has been relatively comprehensive. The remainder of the chapter deals with research in the Caribbean and in the Western Indian Ocean. As explained in Chapter 1, coverage for these areas is necessarily a great deal more superficial than for the South Pacific.

RESEARCH IN THE CARIBBEAN

Historic Development

3.108. Fisheries development in the islands of the Caribbean has received varying attention since 1945. During the 1940s, the Anglo-American Caribbean Commission concluded that fisheries development should emphasize careful management and cautious application of technology to increase catches without depleting stocks. The emphasis was on the importance and vulnerability of traditional fisheries and the needs of artisanal fishermen.

3.109. In the 1960s, the desire for modern technology dominated development activities, and the emphasis was on projections of fisheries potentials which would attract investment capital. A product of this was the first comprehensive regional fisheries development effort, the Caribbean Fisheries Development Project (CFDP), administered by FAO and funded by the UNDP. It was a pre-investment survey of fishery resources with a primary focus on exploratory fishing. Other components were a training program for fishermen and demonstrations in marketing, processing and project development. The Project ran from 1965-1971 with its principal emphasis on the development of large-scale commercial fisheries.

3.110. The Western Central Atlantic Fisheries Commission (WECAFC) was formed in 1973 as an advisory body to FAO. Under the auspices of FAO and UNDP, the Commission established the International Project for the Development of Fisheries in the Western Central Atlantic (the WECAF Project) which ran from 1977-1981. The objectives of the Project were to:

"Assist in ensuring the full rational utilisation of the fishery resources in the Western Central Atlantic through: the development of underexploited stocks, particularly those accessible to small-scale fisheries; the promotion of better use of existing catches; and, appropriate management actions for stocks that are heavily exploited."

3.111. WECAFC has continued its involvement in Caribbean fisheries research and development by hosting biennial Working Parties on Marine Resource Assessment and Fishery Economics and Planning, and by creating the FAO WECAFC Lesser Antilles Committee which hosts biennial meetings of fisheries personnel and experts from the Lesser Antilles. The biennial meetings are important for exchanging fisheries information and establishing priorities for fisheries research and development. Proceedings of the Working Party sessions and meetings are published as FAO Fisheries Reports.

3.112. The Gulf and Caribbean Fisheries Institute (GCFI) is a non-profit organization founded over 40 years ago to increase communication and the exchange of information about regional fisheries. GCFI hosts an annual meeting which is important in facilitating exchanges of ideas on fisheries research and on the status of stocks. Proceedings of the meetings are published annually.

3.113. The University of the West Indies is a regional government-supported institution founded in 1949 which achieved University status in 1962. There are 3 campuses; Mona, Jamaica, Cave Hill, Barbados, and St. Augustine, Trinidad. Zoology at Mona, typically through the Port Royal or Discovery Bay marine laboratories, and Biology at Cave Hill, typically in association with Bellairs Research Institute, have been the Departments most involved in fisheries research. Major fisheries research programs at Mona include the Biology and Exploitation of Adult Reef Fisheries in Jamaica, sponsored by the Overseas Development Administration of the British Government, and a large-scale project on the feasibility of oyster aquaculture, sponsored by the British Government. Major projects at Cave Hill include the IDRC-sponsored Eastern Caribbean Flyingfish Project and an IDRC-sponsored project on stock structure and rehabilitation of sea urchin populations in the eastern Caribbean. Recently, a Center for Resource Management and Environmental Studies (CERMES), sponsored by ICOD, has been established at Cave Hill.

3.114. Bellairs Research Institute, founded in 1954, is a non-profit organisation based in Barbados. It has been affiliated with McGill University since 1954, and with the University of the West Indies since 1986. Much of the early research on the biology and population dynamics of commercially exploited marine organisms in the eastern Caribbean was conducted at Bellairs. Current projects (in collaboration with U.W.I.) include the Eastern Caribbean Flyingfish Project, stock structure and rehabilitation of sea urchin populations, nest success and rehabilitation of marine turtles, and the effects of "ghost-fishing" on reef fisheries.

3.115. The Caribbean Community (CARICOM) Secretariat was founded in 1973 and is based in Guyana. Member States are currently Antigua and Barbuda, the Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Montserrat, St. Kitts-Nevis, St. Lucia, St. Vincent and the Grenadines, and Trinidad and Tobago. CARICOM seeks to play a key role in regional fisheries development, but has not established a formal Fisheries Desk, and has expressed the intention of collaborating with OECS and FAO in fisheries development. In 1980, CARICOM coordinated a regional fisheries economic study and a regional fisheries marketing survey. CARICOM organizes occasional Technical Fisheries Seminars at which representatives of Member States identify constraints to fisheries development and discuss solutions.

3.116. The Institute of Marine Affairs (IMA) is a Government non-profit research institute founded in 1976 and based in Trinidad and Tobago. The Institute has five Research and Development Divisions: Coastal Area Planning and Management, Natural Resources, Environmental Quality, Information services and Socio-economic and Legal Issues. Its activities have traditionally been national (Trinidad and Tobago) in scope, but it is currently seeking to develop a regional thrust.

3.117. The Eastern Caribbean Natural Area Management Program (ECNAMP) is a non-profit organisation registered in the U.S. Virgin Islands and St. Lucia and established in 1977. It is primarily an implementing agency, with activities related to natural resources management. Recent fisheries-oriented projects include a Program for Coastal Resource Management in St. Lucia, and seaweed aquaculture in St. Lucia, Grenada and Carriacou.

3.118. The Organisation of Eastern Caribbean States (OECS) is a regional governmental organisation established in 1981. Member States are currently Antigua and Barbuda, Dominica, Grenada, Montserrat, St. Kitts-Nevis, St. Lucia, and St. Vincent and the Grenadines. With sponsorship from ICOD, OECS established a Fisheries Unit in 1986. Its activities are directed towards management of fisheries in OECS Member States. Current activities of the Fisheries Unit include: the OECS Data Enhancement Project, which attempts to build on and implement suggestions arising from an FAO Workshop on Fishery Data Collection Systems for Eastern Caribbean Islands; a project on harmonisation of fisheries regulations in OECS Member States, which attempts to facilitate implementation of a series of FAO Workshops on the regional (OECS) harmonisation of fisheries legislation; and a Marketing Survey Project for OECS countries. The Fishery Unit publishes a Newsletter and an OECS Fishery Report series.

3.119. Attitudes towards research have changed greatly in recent years. In the 1970s, emphasis was on defining biological resources and estimating their productivity. Recently the problems of managing the fisheries have required a broadened approach that recognizes fisheries as "systems" wherein the biological yield is seen as only one component of an interactive network. Elements in the interactions extend from technological aspects of

fishing, fish landing, processing and marketing through socio-economic relationships within fishing communities to considerations of long-term investment requirements.

3.120. Whereas the research needs have become more complex and demanding, the capacities of small island governments to deal with them are severely limited. As yet, there is not a strong tradition of fishery resource management in the CARICOM region. There are severe institutional limitations, limited expertise, and minimal data on which to base fishery management strategies.

3.121. Fisheries Divisions of CARICOM Member States are generally under-staffed considering the extent of their responsibilities. The prominent requirement in most fisheries is more and better information, particularly information required to evaluate the feasibility of particular management strategies for various resources and to evaluate the socio-economic impacts of various management options.

Inshore Resources

Reef and Lagoon Fishes

3.122. As outlined in the previous chapter, the inshore reef resources throughout the Caribbean are heavily exploited and, in many areas, in need of rehabilitation. Management to improve the circumstances of the fishery will require major flows of information and action programmes involving fishing communities.

3.123. Assuming that governments will wish to maintain small-scale reef-fish fisheries, management measures will need to be simple and not require extensive surveillance and enforcement.

3.124. Regional fisheries experts consider that management would first of all require engaging local communities in efforts to reduce fishing mortality, especially on juvenile fishes. Measures to require use of traps with larger mesh sizes may be the most effective single step. Information on size at maturity, a prerequisite for selecting an appropriate mesh size, is lacking for most of the species taken in these fisheries. However, it is felt that with the cooperation of fishermen, preliminary information could be obtained in as little as one year.

3.125. Selection of a mesh size should also take into account information on both recruitment and growth overfishing. Such information may require more technically complex yield per recruit studies based on more extensive population sampling.

3.126. If trap mesh-size regulations did not result in sufficient stock recovery, limits on the total capacity of the fishery would be required. Given the artisanal, small-scale nature of reef fish fisheries, attempts to limit the number of participants in the fishery will be difficult to enforce from outside, and may have unacceptable socio-economic impacts, such as the elimination of the main source of dietary protein in small fishing communities.

3.127. Ideally, this approach to management should be based on some estimate of potential yield from a given shelf area, and of its relation to the catch taken per trap. If it is clear that the resource is overexploited, one possible course may be to license all existing fishermen, allow fishing effort to become reduced by attrition, and monitor catch rates and species composition in order to identify appropriate effort levels.

3.128. Estimates of potential yield from island shelves are highly variable, probably due to differences in the relative proportions of habitat types (sand, reef, seagrass), and have generally been based on observed catches. Surplus production modelling of yields for reef fish assemblages has frequently been suggested as a possible extension of a single species method to a multispecies fishery, but has never been successfully applied. Application of this method would require several years of catch and effort data.

3.129. An alternative, similar to that tried for the parishes in Jamaica, would be to compare islands with differing levels of fishing effort per unit shelf area. The result would be relatively crude estimates of the expected total yield of reef fishes on an island-specific basis, and of the number of traps per island necessary to obtain the yield.

3.130. The harvesting of small species, and juveniles of large species, for export in the aquarium fish trade is an issue which requires attention. In most CARICOM countries permission must be obtained from the Fisheries Officer to collect and export aquarium fishes. However, there is very little information on which to base decisions regarding allowing or prohibiting this practice.

3.131. From the foregoing, it is apparent that there are major research challenges if depleted reef and lagoon resources are to be rehabilitated.

Lobster

3.132. As outlined in the preceding chapter, lobster are an extremely important target of Caribbean fisheries. Heavy fishing undoubtedly results in the lobsters being taken when they are smaller than desirable to maximise yields. Whether or not the heavy fishing pressure affects recruitment is not known.

3.133. Young lobster inhabit inshore habitats which are subject to destruction and degradation. If diminished recruitment is documented, research will be necessary to distinguish between the effects of stock depletion and juvenile habitat loss or degradation.

3.134. In order to realise the full potential of the lobster resource, rehabilitation of overexploited areas and subsequent careful management will be required.

3.135. Effective management requires:

- Enforcement of current regulations; and,
- establishment of data collection systems for monitoring catch, effort and size composition of the catch in order to evaluate the response of the resource to the above enforcement.

Conch

3.136. Conch are an extremely important product in the Caribbean and are subject to intensive harvest virtually everywhere they are found.

3.137. From a biological point of view conch should probably be managed locally, with management units no larger than the island shelf. However, as there may be interdependence among areas for recruitment, overfishing in one shelf may affect neighbouring areas. Research is needed to determine the extent of such interdependence.

3.138. In order to realise the potential of the conch resource in the region, stock rehabilitation followed by careful husbandry will be required.

3.139. The most urgent management requirements for conch include enforcement of current regulations, and establishment of data collection systems for monitoring catch, effort, and size composition of the catch in order to evaluate the response of the resource to the above enforcement.

Nearshore Resources

Deep Slope and Bank Fishes

3.140. As outlined in the previous chapter, recent growth of fisheries for deep slope and bank fish has been rapid and in three to five years, the resource could become fully exploited or overexploited. In any one place deep slope and bank fisheries tend to harvest a less diverse assemblage than reef fish fisheries, and size limits aimed at reducing growth and recruitment overfishing could be the most effective approach to protect the fishery.

3.141. As for reef fishes, research will be required to provide the necessary biological background information if appropriate size limit regulations are to be developed.

3.142. There is a likelihood that size regulations may only be partially effective. Measures to control the size of landed fish could result in discarding of small fish at sea. Since these fishes are caught in deep water, most discards would die. Other measures may have to be considered. Studies of the relationships between gear characteristics (hook size, mesh size) and the size of fish caught could be useful. In the long term, direct limitation of fishing effort will probably be required if overexploitation is to be prevented.

3.143. Thus, as with the inner reef fisheries, substantial research efforts may be required to prevent overexploitation of the resources of deep slope and bank fishes.

Continental Shelf Demersals

3.144. As discussed in the previous chapter, shared stocks of shrimp in the Guyana-Brazil support substantial fisheries that are in need of management but for which there are no international arrangements to provide for cooperative action.

3.145. A report of a recent workshop² describes the state of the fisheries in each country, the availability of statistics, the biological assessment of the shrimp stocks, and the management recommendations of the workshop. The workshop concluded that there was a great deal of mixing among shrimp stocks in the region and that effective management will require a cooperative effort. A proposal for a project to conduct joint research and management was drawn up and is under consideration by the participating countries.

3.146. Given the value of this resource, and its dynamic nature, sophisticated resource assessment techniques are probably warranted. These could include development of age/size structured models of growth, mortality, and reproduction, as well as investigation of the environmental factors contributing to recruitment variability. Effective management would undoubtedly require close monitoring of stock abundance and annual yields.

3.147. There are growing concerns that continuing degradation and destruction of coastal nursery habitats, such as swamps, estuaries and lagoons are a major cause of the continuing decline in catches off Guyana. More conclusive evidence for the role of coastal nursery areas in producing recruits for the fishery is needed.

3.148. There have been numerous surveys of the demersal shrimp and fish resources on the continental shelf off northern South America. These have resulted in several estimates of potential yields, based on biomass estimates from catch rates of trawls, using swept area and various assumed catchability coefficients.³

3.149. As discussed in the previous chapter, although the demersal fish species on the shelf are targeted by small-scale inshore fisheries, by far the greatest part of their exploitation is as bycatch in shrimp trawls; there are signs that such bycatches may be causing declines in the stocks.

3.150. Clearly there are important needs for cooperative research if the shared shelf stocks are to be protected.

Coastal Pelagics

3.151. Coastal pelagics (jacks, ballahoo, scads, bonito, etc.) are heavily fished almost everywhere throughout the Caribbean. There is virtually no information on the status of the stocks or on their migration patterns.

Oceanic Resources

3.152. There is little local research on oceanic pelagics (most of which conduct broad migrations both within and outside the region) in the Caribbean area. In particular, for the non-tuna large pelagics such as dolphin, wahoo and mackerel, little is known about migration, stock structure and exploitation rates.

3.153. There is concern about the swordfish stocks. United States catches of swordfish in the Caribbean outside the United States EEZ have grown in recent years. United States studies on swordfish have shown declines in the mean weights of swordfish caught. Minimisation of capture of small fish would seem desirable.

3.154. One way of achieving this would be to close areas and seasons where high proportions of small fish were caught. The patterns of catch by size indicate that it would be possible to implement this strategy. Minimum size regulations would probably be ineffective due to mortality of released fish. The success of setting TACs or limiting total effort would depend on good estimates of fishing mortality for the entire stock, and having the means of estimating the proportion of the catch which would be expected from a particular EEZ.

3.155. The International Commission for the Conservation of Atlantic Tunas (ICCAT) is charged with the monitoring of the Atlantic tuna fisheries, including those of the Caribbean area. However, due to inadequacies in the database, the status of the stocks in the Western Atlantic is poorly known.

3.156. Because most of the tuna caught in the area are taken by distant-water fishing fleets, it is very difficult for CARICOM countries to take measures on their own to improve the collection of information required to make better assessments of the resource as a basis for possible future regional fisheries developments. This subject is discussed in more detail in the next chapter.

Flyingfish

3.157. As outlined earlier, exploitation of flying fish in most parts of the Eastern Caribbean is steadily expanding. The stocks are probably shared between the countries. On the basis of experience in other fisheries it can be assumed that, without controls, the fishery will become too intense and will require limitation. The status of the stocks is not well known and more research will be required if effective cooperative measures are to be developed.

3.158. Limitation of fleet size would seem to be the most appropriate approach. This would require determining equivalencies between vessels (i.e., how many pirogues equal one "ice boat"?). The situation is complicated by the fact that vessels fishing flyingfish harvest other species as well and the fleet size appropriate for the flyingfish fishery may be too small to permit full exploitation of the other species.

3.159. A regional flyingfish assessment program, the Eastern Caribbean Flyingfish Project (ECFFP) being funded by the IDRC, Canada, and implemented by Bellairs Research Institute and the University of the West Indies, is attempting to determine whether there are significant quantities of flyingfish outside of the area in which the fishery now concentrates, and to determine appropriate exploitation rates for the stock.

3.160. Preliminary analyses suggest that, owing to a considerable inter-annual variability in the abundance of flyingfish, traditional deterministic stock assessment methods will not be applicable. Instead, an approach which attempts to evaluate the risks of and returns from various fishing options will be considered.

Unexploited Species

3.161. The UNDP/FAO Project carried out exploratory fishing throughout the Caribbean and along the Guyana shelf between 1965 and 1971. The conclusion was that there were few unexploited resources on which to base any significant commercial fishery expansion. More recently, the UNDP/NORAD survey with the RV *Fridtjof Nansen* explored the waters of the continental shelf from Trinidad to Suriname using trawls and acoustic survey equipment, but the results of this survey are not yet available. However, the conclusions of the UNDP/FAO exercise are probably still valid for finfishes of the continental and island shelves, and for the surface waters of the open ocean. Nevertheless, some focused exploratory fishing may indicate localised stocks, particularly of invertebrates, which may be profitably exploited. More specifically, there are indications that commercially valuable quantities of deep-water crabs may occur in the region. Exploratory fishing for squids may also prove to be of importance. Most of the squid now used as bait in the rapidly expanding long-line fisheries in the region are imported.

WESTERN INDIAN OCEAN

National Research

3.162. The four island countries under study in the Western Indian Ocean (Comoros, Maldives, Mauritius and Seychelles), were all dependencies of colonial powers until they achieved independence in the late 1960s or mid 1970s. A limited amount of fishery survey work was done in Mauritius and Seychelles in colonial times.

3.163. In the small island countries of the Southwest Indian Ocean, most fisheries are of a commercial rather than of a subsistence nature. Unlike the situation in most South Pacific and Caribbean countries, beginning in the late 1970s, significant efforts have been expended by the Indian Ocean states to estimate catches of fish and other marine products in the small-scale fisheries. Mauritius and Seychelles have developed research units within their fisheries agencies with budgets and staffs substantially larger than those in most South Pacific and Caribbean countries. Seychelles in particular, has very efficient and sophisticated systems for collection of catch, effort and sampling information and for stock assessment. Emphasis is placed on the monitoring of foreign tuna fishing activity.⁸

3.164. Relatively little specific research has been conducted on inner reef species, although there have been some preliminary production assessments including specific assessments for rabbitfish (Mauritius) and for Indian mackerel and tuna baitfish (Seychelles).

2.165. In Comoros, collection of information on the fisheries is at an early stage of development. The Maldives, with a large local fishery for tuna, has recently established a Marine Research Section within the Ministry of Fisheries to carry out tuna stock assessments and studies on reef fish and the marine environment. Catch and effort data on tuna exports has been collected since the 1960s.⁹

Regional Programmes

3.166. Beginning in the 1960s, successive regional programmes developed through FAO have either carried out or supported research in the Indian Ocean. These include the Indian Ocean Programme and the current Southwest Indian Ocean Project.

3.167. In the 1970s and early 1980s, FAO's work in the Southwest Indian Ocean involved mainly trawling and acoustic surveys conducted by the research vessels *Fridtjof Nansen* (supported by NORAD) and *Professor Mesyatsev*.

3.168. The Indian Ocean Programme encompassed all the developing countries bordering the Indian Ocean. A new project (the Regional Project for the Development and Management of the Fisheries of the Southwest Indian Ocean - SWIOP) initiated in 1981, involves only the Southwest Indian Ocean (omitting the eastern part that encompasses the Maldives).

3.169. The SWIOP initially was directed towards formulating development programmes to upgrade traditional fisheries. The work involved gaining information on the resources and harvesting methods through test fishing and surveys; developing stock assessment methods; training technicians and administrators; promoting the development and exchange of data bases; and, promoting capabilities for monitoring, control and surveillance.¹⁰

3.170. In 1986, the emphasis changed, aimed chiefly at strengthening the institutional bases in the countries.

3.171. In brief, the Project's new objectives have been to assist countries to develop their fisheries establishments (in terms of appropriate staffing, organisation, etc.) in order to; develop effective fisheries policies and strategies; identify technical assistance needs, investment potentials and sources of funding; develop effective statistical systems useful for management; develop national staffs trained in assessment and monitoring of resources and the economic performance and social effects of development; and, coordinate fisheries development and management on a regional basis.

3.172. From the research point of view, the Project's output has included a workshop on the assessment of fishery resources in the region in which papers by each of the 11 countries or territories served by the Project were reviewed. The workshop report provided a compendium of information on the status and utilisation of fisheries resources throughout the region.¹¹

3.173. In conjunction with national research programmes, ORSTOM carries out work in Comoros, Mauritius and Seychelles, while the European Community-supported Association Thoniere tuna project (due to terminate in June 1990) carries out training, research and exploratory tuna fishing around Comoros, Réunion, Madagascar and Mauritius.

3.174. Since 1985, FAO has executed a UNDP-funded Indo-Pacific Tuna Programme with headquarters in Colombo, Sri Lanka. The project, which covers the Indian Ocean and waters to the east around Malaysia, the Philippines, Indonesia and Thailand, collates catch and effort data, assists countries to upgrade statistical and biological sampling, and convenes annual expert consultations, bringing together scientists to review the status of tuna stocks and to coordinate research.

NOTES

1. See footnotes 5 and 7 of Chapter 1.
 2. However, a considerable body of information has been developed on the problems of multispecies, multigear fisheries in other parts of the world. An extremely useful Workshop on Pacific Inshore Fisheries Resources convened by the South Pacific Commission in 1988 reviewed much of the available information on the subject.
 3. Munro, J.L. and S. Fakahau. 1986. Methods for the appraisal of coastal fishery resources in the South Pacific region. Forum Fisheries Agency. Report Number 86/60. 41 p.
 4. King, M. and A. McIlgorm. 1989. Fisheries biology and management for Pacific Island students. Produced for the University of the South Pacific by the International Development Program of Australian Universities and Colleges. 67 p.
 5. It should be noted that there is a strong undergraduate and postgraduate marine sciences programme at the University of Guam.
 6. Erhardt, N.M. 1986. The biological and economic modelling of shrimp resources on the Guyanas-Brazil Shelf. Summary Report of the Workshop. University of Miami. Miami, Florida. 48 p.
 7. Klima, E.F. 1976. A review of the fishery resources of the Western Central Atlantic. WECAF Studies 3. 77 p.
- Stevenson, D.K. 1982. A review of the marine resources of the Western Central Atlantic Fisheries Commission (WECAFC) Region. FAO Fish. Tech. Pap. 211. 132 p.
- Losse, G.F. 1982. Report on the fisheries survey. 1981-82 (Draft). Plan for fisheries development in the Republic of Suriname. 128 p.
- Fabres, B.A. 1982. Demersal fish potential of the Atlantic West Grounds, South America. M.Sc. Thesis. Florida State Univ. 94 p.

8. For example, see:

Sanders, M.J. 1986. Documentation of the Work Programme for the Fisheries Research and Development Division (Mauritius). RAF/79/065/WP/27/86. 35 p.

9. Anon. 1988. Fisheries research and development activities in the Maldives. Country Status Paper. Regional Consultation on Fisheries Information, October 5-7, 1988.

10. Anon. 1988. Terminal Report Phase 3. Regional Fisheries Development and Management Project for the Southwest Indian Ocean: RAF/79/065. 28 p.

11. Sanders, M.J., P. Sparre and S.C. Venema (Eds.), 1988: Proceedings of the workshop on the assessment of the fishery resources in the Southwest Indian Ocean. FAO/UNDP: RAF/79/065/WP/41/88/E: 277 p.

CHAPTER 4

REMAINING PROBLEMS AND POSSIBLE AVENUES FOR SOLUTION

INTRODUCTION

4.1. This chapter attempts to provide a general characterisation of the problems associated with fisheries research in each of the three regions under study and to suggest fruitful avenues for future activities which could result in improvements. Attempts to draw more general conclusions, applicable to small island countries in general, is reserved for the final chapter.

THE SOUTH PACIFIC

4.2. In the foregoing chapter, it was concluded that there had been substantial improvements in the extent of regional support for research, particularly in the field of communication. To date, however, this improved support has not had a substantial impact on the operations of national fisheries departments. In most countries, fisheries research has yet to make a significant contribution to management and development programmes.

4.3. Island governments have not placed a high priority on fisheries research and the number of fisheries research staff and their levels of skills tend to be far lower than required to meet existing needs. The challenge for island countries is to build their own capabilities to conduct research independently or to effectively utilise the very substantial technical and financial assistance available in the region through regional and international agencies and bilateral donors. Regional fisheries organisations have an important role to play in assisting countries to achieve these goals.

Levels of National Funding and Staffing

4.4. Most island countries have small populations and meagre national budgets which militate against the proliferation of government agencies and growth of the civil service. As a result, fisheries staffs are typically very small, even in countries where exploitation of fisheries resources provides a significant contribution to national revenue. As outlined in the previous chapter, many island fisheries departments are turning to external assistance for extra-budgetary funding to meet shortfalls in national capabilities.

4.5. Research staffs are often required to perform functions other than research and are frequently moved from project to project to "fight fires". Some countries, with no staff dedicated to research, use development and extension staff to carry out surveys and fisheries monitoring. Dedicating personnel and funding to long-term research projects, particularly to the tedious task of monitoring the performance of fisheries, is often very difficult.

4.6. Staffing and internal funding are obviously matters of national prerogative and will not be addressed in detail in this report. However, it would seem appropriate to comment that, under tight budgetary and personnel constraints, it is in the interest of governments to ensure that the personnel recruited or those already on staff, are used as effectively as possible.

4.7. This requires planning for both the short and the long term, involving the careful selection of programmes and determination to see such programmes through to completion. It also requires careful selection and training of staff so that each department's capabilities are closely matched to the technical demands of the management and development projects being undertaken.

4.8. In the South Pacific, other than the conduct of exploratory resource surveys, research at the national level is at an early stage of development and, in a number of countries, has not yet demonstrated its value in supporting management and development programmes. Under such circumstances, expanded support for research may have to await more concrete demonstrations of its value.

4.9. **Conclusion:** Effective utilisation of scarce personnel and funding at the national level may be facilitated by improved planning of research activities in both the short and long term, including the establishment of research objectives, the identification of appropriate projects and development of strategies for their implementation. Regional organisations could assist in the formulation of such plans.

Attractiveness of Fisheries as a Vocation

4.10. There is a serious lack of university graduates available for recruitment to government fisheries services throughout the region. In part, this is due to lower levels of the education system failing to produce sufficient numbers of students qualifying for university entrance. As a result, a number of fisheries-oriented university courses are underutilised.

4.11. In fisheries, as in other technical fields, there are additional problems; among islanders, scientific endeavour is not highly regarded as an avocation. Despite the fact that many island states recognise the great value of fisheries to their countries, as a career, fisheries is not accorded a high status (often reflected in low gradings within government services) as opposed to careers in other fields (e.g., finance, diplomacy, etc.). Partially due to this perception, there are relatively few students graduating from Universities with training in science appropriate for fisheries research.

4.12. There is often an inadequate understanding of the need to carry out research in order to develop the necessary information base to plan and monitor fisheries management and development programmes. The South Pacific Regional Environment Programme (SPREP) is working in this field, producing educational material to increase awareness of the importance of preserving the marine environment, including conservation of reef resources, but material pertaining directly to fisheries is limited.

4.13. Considering the importance of the sea and its resources to the region, for the long term, it would seem desirable to promote better understanding of conservation (including environmental protection) in management and development programmes, and of the integral role of research within the framework of such programmes. Such increased awareness would best be developed by introducing educational material into school and university curricula.¹

4.14. More specific approaches might be taken to elicit interest on the part of government manpower planners and school leavers considering entering university. This might involve making material available that details the scope of career opportunities available in fisheries.

4.15. **Conclusion:** To increase awareness of the value of fisheries research in management and development programmes and of the possibilities available in careers in fisheries research, educational material could be prepared for distribution to the general public and made available for incorporation into secondary school and university curricula.

Communication and Collaboration

4.16. As discussed in the previous chapter, effective exchange of information and ideas and collaboration on a regional level are an important means of ensuring effective utilisation of scarce regional personnel. The 1986 reports recommended substantial strengthening of regional efforts to improve communications. The preceding chapter revealed that substantial progress had been made in this field in recent years.

4.17. Whereas some progress has been made, there remain shortcomings in the capacity of island technical staffs to develop mechanisms for cooperation. One problem is simply shortages of staff, with pressing day to day duties impeding the development of effective regional dialogue.

4.18. A particular difficulty is the documentation of the results of research in individual countries. Aside from not having such information available within countries, this lack of documentation reduces the value of projects aimed at exchanging data between countries. There would seem to be a lack of training in the region in scientific reporting and a general low priority given to preparation of reports. The dangers of loss of

information and duplication of effort through lack of reporting and rapid turnovers of personnel were addressed in the 1986 reports.

4.19. **Conclusion:** Documentation of research remains a shortcoming in a number of countries. Training in scientific reporting within the region would appear to be a useful area for expansion. In the short term, regional organisations could assist countries to update reporting within countries.

Training

4.20. Making the most efficient use of slim personnel resources and ensuring that staff are appropriately trained for their specific duties, is a matter of growing concern to island fisheries departments. A decade ago, there was relatively little training in fisheries readily available to island governments. As outlined in the previous chapter, in recent years there has been a proliferation of regional and bilateral training programmes from the practical field level through post-graduate training in Universities.

4.21. The point was made above that, despite a plentiful supply of training opportunities, the results of the training have not been impressive and capabilities of most island fisheries departments have fallen below expectations. A number of factors seem to contribute to this deficiency:

- For comprehensive training to be effective, careful planning to match available training opportunities to specific needs is required. Few countries have structured personnel development programmes for research workers, instead taking advantage of training courses on an opportunistic basis.
- Some training institutions appear not to have clear understandings of regional needs, leading to inappropriateness in their offerings.
- The quality of instruction in training courses is variable.
- There is little coordination between training agencies in the region. In addition to some training being inappropriate, there is unnecessary overlap, and there are obvious gaps in the availability of training opportunities.
- Administrative and organisational difficulties within the regional universities have resulted in those institutions not meeting regional expectations for their development as centres of excellence for the training of fisheries workers.
- With certain notable exceptions (e.g., SPC's training of extension workers), most regional training has little follow-up within countries. The result is that workers lack guidance when they begin to apply their new skills, and training thus fails to be fully effective.

4.22. A common problem in the South Pacific is that, at any one time, there may be relatively few people requiring training in specialised fields and even then, such demand may be periodic. Training agencies, often geared to regular repetitive offerings of their courses, find such small and irregular requirements difficult to deal with.

4.23. Training facilities are being unevenly and sometimes inappropriately used. This results in some facilities being underutilised, some trainees being disappointed in the training they receive, and the expectations of national fisheries agencies not being realised.

4.24. The most serious deficiency would seem to be the current decline in the contributions of the regional universities which are depended upon to provide core training for both professional and diploma-level fisheries workers. Training in biology and general science is required at the undergraduate level, with opportunities being provided for researchers to use their in-country studies as a basis for obtaining higher degrees.²

4.25. Training in the complementary fields of fisheries economics and sociology are essentially non-existent. Training opportunities in both fields are sorely needed.

4.26. It is beyond the scope of this review to discuss the problems existing in the universities. It is encouraging to note that USP is attempting to strengthen its performance (e.g., the recent review of IMR and the appointment of a coordinating professor for all marine activities within the university). However, these initiatives have yet to bear fruit. Slowness of the university to strengthen its programmes has led to informal discussions of alternative approaches to development of core training in the region, including the establishment of new institutions.

4.27. Conclusion: Fisheries training in the South Pacific, though plentiful and varied, has not led to significant improvement in the ability of island fisheries departments to increase their domestic capabilities to the extent hoped for. A number of measures might bring about such improvements, including:

- Acceleration of efforts to strengthen USP's activities (including IMR's functions) in the marine field or developing other approaches to upgrading core training in fisheries. Both FFA and SPC are in influential positions in USP coordinating and advisory groups and could play a pivotal role in bringing about positive changes;
- efforts to increase the level of competence of trainers. In the short term, cooperative tutor exchange and personalised personnel development programmes involving experienced Pacific Rim institutions might be explored;
- regional training institutions should make special efforts to design and organise *ad hoc* training in certain specialist areas where there is small and infrequent demand. Attachment training combined with provision of instruction by correspondence might be useful in this regard;
- assistance to countries in organising comprehensive personnel development plans to match training with future needs for skills or blends of skills. Such planning might involve:
 - in the short term, identifying the skills and levels of competence required within each country to achieve management and development objectives;
 - on the basis of such assessments, identifying suitable training opportunities for existing staff and appropriate external technical assistance to fill in gaps where local skills are lacking; and,
 - in the long term, developing comprehensive plans for personnel training and professional development, anticipating future trends in management and development programmes.

Regional agencies could assist countries in the development of such plans by encouraging consultations between training agencies to:

- create a perspective of the entire spectrum of regional training activities;
- identify gaps and, on the basis of knowledge of country requirements;
- assess the degree to which regional training opportunities are meeting country requirements.

A regional meeting of training establishments (including the universities) would seem appropriate.

Research Activities of Regional Organisations

4.28. The present report has concentrated on research activities at the national level, but has indicated areas in which regional organisations can assist countries to increase their research capabilities. The September 1989 FFA Conference gave consideration to the contributions of regional and international organisations to research and expressed general satisfaction with the roles played by various agencies and with their performances. FFA's functions, including that of its recently appointed Research Coordinator, were considered appropriate. A statement of functions outlining the Coordinator's role in facilitating research was included in the Agency's Corporate Plan. The present report will not expand on the activities of regional organisations except to reiterate that recommendations in the 1986 reports regarding the activities of regional organisations have largely been met.

4.29. One institutional constraint should be mentioned, however, and that relates to the availability of tuna catch data. Problems continue to be experienced in obtaining complete and accurate statistics and adequate biological information on all tuna harvested by distant-water fleets. Progress has been made (particularly through the conclusion of the multilateral Treaty on Fisheries with the United States), but coverage is still far from complete. Solutions lie in the field of diplomacy and are beyond the purview of this report.

THE CARIBBEAN

National Funding and Staffing

4.30. As in many South Pacific countries, most national fisheries agencies in the Caribbean are badly understaffed. Personnel are therefore expected to deal with a great diversity of fisheries related problems, usually with tightly constrained fisheries budgets. They are often inexperienced in the concepts, tools and strategies of fisheries management.

4.31. The consequence is that approaches to fisheries management and research tend to be reactive and planning for fishery management is almost universally inadequate. Many national fisheries agencies therefore need assistance with the preparation of National Fishery Management Plans that involve:

- Establishing goals and objectives;
- determining the best means to achieve them;
- determining research requirements for attaining the objectives;
- developing means of monitoring programmes and modifying them to adjust to changing circumstance.

There is an urgent requirement for focused "hands-on" opportunities for training in this field.

4.32. The constraints on staffing and funding for national fishery agencies are partly the consequence of the low priority given to fisheries by governments and lack of understanding of the financial and personnel commitments that are required for successful fisheries management and development.

Monitoring and Processing of Catch Statistics

4.33. Monitoring catch, effort and socio-economic indicators of fisheries is a prerequisite to their effective management. Although basic catch and effort recording systems exist in most countries, there is a need to improve the reliability and scope of the data. Adequate monitoring will require the development of licensing systems with associated requirements for reporting.

4.34. A recent FAO/OECS/ICOD Workshop on Fishery Data Collection and the current OECS/ICOD Project have made a good start in upgrading the quality of fisheries data and computerising it in OECS

countries. Similar projects are underway in the Bahamas, Barbados and Trinidad and Tobago. There is a need to extend these activities to all CARICOM countries, and to facilitate exchange of data between countries to ensure that the systems developed are compatible.

Institutional Arrangements, Communication and Collaboration

4.35. Because the populations of many of the island countries of the Caribbean are so small, every national fishery agency cannot develop the full range of skills and expertise necessary for effective fishery management. There is therefore a need for countries to be very selective in choosing fields for specialisation and in the structuring of their research activities.

4.36. Under such circumstances, there is a need to develop effective methods for sharing the scarce regional expertise in certain fields and in developing efficient means for communication and collaboration between national, regional and extra-regional institutions.

4.37. This need would seem to be particularly appropriate in the Caribbean considering that many of the major fishery resources in the region may be shared stocks, either because adults migrate between zones (in the case of oceanic resources) or because of widespread dispersal patterns of larvae and juveniles (in the case of inshore and nearshore resources).

4.38. To ensure effective communication and collaboration, it would be desirable to develop systems to increase interactions between institutions in cooperative research, assessment and management. This may necessitate creation of relatively 'formal' advisory and decision-making mechanisms.

Resource Assessment Projects

4.39. Research requirements vary greatly between resources or complexes of resources. It is therefore necessary to develop and fund research on a resource-specific basis.

Community Involvement and Habitat Management

4.40. Effective management of the Caribbean fisheries (most of which are small-scale) requires the positive participation of fishermen, not only through adhering to regulations that may be developed, but also in the collection of information (i.e., research). Development of appropriate mechanisms to ensure full and constructive participation of fishing communities in the fishery research and management process will be required.

4.41. There is a need for increasing awareness of the fact that management of nearshore and inshore fisheries is unlikely to be successful if there is deterioration of the coastal habitats on which the fisheries depend. Measures to integrate fisheries management with management of coastal fish habitats are necessary throughout the region.

THE WESTERN INDIAN OCEAN

Constraints to Research

4.42. It was not possible to carry out consultations such as would be required to develop a comprehensive assessment of research problems in the Western Indian Ocean Region. It is likely that, at least for the less developed countries in the region (Comoros and Maldives), many of the problems faced by small Pacific island countries also exist in the Western Indian Ocean. Lack of trained staff and funding would be particularly important.

4.43. On the basis of brief consultations with members of national fisheries staffs and SWIOF experts in Seychelles, there would appear to be a number of general problems constraining the collection of information required for management and development. These general problems are described below.

Lack of Staff Capability and Focus

4.44. Staff of national fisheries agencies are generally lacking in knowledge concerning concepts, instruments and strategies of fisheries management, and hence either give insufficient attention to research (for management) or undertake research in an academic rather than an applied context. Possible approaches to overcoming this deficiency include improved training or frequent participation in management formulation exercises led by "outside" specialists (e.g. workshops on stock assessment of resources on a region-wide basis).

4.45. The need for training in research methods in respect of stock assessment, economic assessments and bio-economic modelling is widely acknowledged. The SWIOP has conducted a number of courses and practical exercises to meet the need. As methods and tools of research change (e.g. micro-computers), repeated upgrading of training in these subjects will be required.

Institutional Inadequacies

4.46. In countries such as Comoros, the fisheries administrations are extremely small and inexperienced and there are no persons on staff with responsibility for research. In other places, the institutional structures and the assignment of responsibilities (sometimes with several ministries having responsibility for fisheries) coupled with poor remuneration levels for staff, act as serious constraints to the conduct of worthwhile research.

4.47. In some cases, the inadequate institutional structure is a consequence of governments not considering fisheries as particularly important to national economics. On the other hand, in some countries such as the Seychelles, the fisheries administration and its research elements are relatively well endowed.

Academic Isolation

4.48. In small island states there is a tendency for the few research staff employed to become isolated, making it difficult for them to keep abreast of new developments and of the published results of others working elsewhere on the same (or similar) species or similar fisheries.

4.49. There are a number of possible approaches to addressing these problems, including the development and maintenance of adequate library services; the establishment of networks of scientists working on like subjects; the regular sponsoring of meetings of researchers (e.g. through regional aid organisations); and possibly the establishment of a regional journal for publishing fisheries or marine science papers.

Research Requirements

4.50. The following are brief assessments of priority areas for research.

Catch Statistics

4.51. While systems for recording basic catch and effort data are in place in most countries, upgrading is required to increase the reliability and usefulness of such data. Required steps include:

- System re-design aimed at achieving output more useful for management and development purposes. Emphasis should be placed on developing outputs stratified by fishery type, and to species stratified according to natural economic groupings;²
- encouraging micro-computer processing of the data, requiring the provision of suitable hardware and software, and training of the relevant technical staff at the national level;

Census and Baseline Socio-Economic Data

4.52. For improved fisheries planning and monitoring, there is a need to improve the data bases of most countries by developing better information on:

- The numbers and types of fishermen, boats and gears;
- the socio-economic characteristics of the fishing communities (e.g. ethnic origins, material well being, age structure, aspirations);
- the available sources of fishery inputs (e.g. capital, fuel, services), and
- the extent of fishermen mobility.

Mapping the Fishing Grounds

4.53. Better information on the distribution of fishing effort and catches is required to develop estimates of productivity per unit area by fishery type. In turn, such information can provide assessments of exploitation levels on the basis of comparisons between like fishery situations. The maps should not only identify the fishing grounds by area, depth location and possibly substrate, but should show the proximity to landing sites and harbours.

Catch Sampling

4.54. Complementary to improved catch statistics there is a need to upgrade sampling of the catches to gain a more accurate picture of species and size composition for stock assessment analyses.

Cost and Earnings Studies

4.55. As background for improved management of the generally heavily exploited fisheries of the region, there is a need for improved economic data. This would be used in conjunction with resource and socio-economic data in bio-economic modelling exercises to investigate the consequences of alternative management strategies.

NOTES

1. A consultancy committee reviewing the performance of the Ocean Resources Management Programme at USP in 1988 reached a similar conclusion regarding the desirability of introducing ocean resources management material into USP extension courses and ultimately into secondary school curricula.
2. The co-operative arrangement between USP and the ICLARM office in Solomon Islands wherein qualified ICLARM scientists supervise students' study programmes is a good example of this type of arrangement.
3. Previous attempts to stratify by species have proven unsuccessful largely due to practical difficulties (e.g., lack of cooperation from industry and inability of enumerators to identify species).

CHAPTER 5

CONCLUSIONS

INTRODUCTION

5.1. As outlined in Chapter 2, the small island countries of the Caribbean, South Pacific and Western Indian Oceans (the regions selected for this review) vary widely in their cultures, population densities, economic circumstances, stages of development and resources. It is therefore difficult to draw general conclusions concerning the circumstances of such countries and their fisheries.

5.2. Nevertheless, despite the fact that there are some prominent exceptions, a number of characteristics are shared by the majority of the countries. In either nature or degree, many of these characteristics tend to set the countries apart from larger continental countries in the same region. On the negative side, these characteristics include:

- a. Small human populations and small economies, creating problems of scale in the development of industries and in training of personnel required for technical development;
- b. except in the Caribbean, geographic isolation with attendant transport and communication problems;
- c. lack of non-fisheries resources, commonly including lack of energy sources, construction materials and water;
- d. with narrow shelves and generally low productivity associated with tropical waters, limited inshore fisheries resources which tend to be heavily exploited; and,
- e. relatively recent achievement of independence with government services still in early stages of development.

5.3. On the positive side, common characteristics of small island countries include:

- a. particularly in the South Pacific and Western Indian Oceans, abundant oceanic tuna resources (currently being exploited mainly by expeditionary fleets of developed countries);
- b. small governments, facilitating internal national communication and decision making;
- c. except for hurricanes, generally salubrious climates; and,
- d. in parts of the South Pacific particularly, low population densities and relatively easy subsistence agriculture making lack of nutrition a rarity.

5.4. Despite the paucity of inshore and nearshore fisheries resources, with very high ratios of ocean area and coastline to land mass and few land-based resources, fisheries in small island nations tend to make relatively more important contributions to the economies and cultural fabric than they do in continental countries in the same regions.

5.5. With the foregoing characterisations as background, consideration is next given to particular problems that face small island countries in conducting research in support of fisheries management and development and to possible approaches to overcoming such problems.

FUTURE INFORMATION REQUIREMENTS

Inshore Resources

5.6. As outlined in the preceding chapters, the resources of the inner reefs and lagoons are of critical economic and social importance to the predominantly rural societies of most small island countries. In most places, the resources are heavily utilised and provide little prospect for expanded development.

5.7. Common characteristics of the inshore fisheries include:

- a. Increasing subsistence or small-scale local market use as a consequence of increasing human populations;
- b. increasing environmental degradation of inshore environments associated with increasing human population growth;
- c. increasing commercial utilisation to serve growing cash markets in rapidly expanding urban centres.

5.8. These trends are leading to depletion of the resources and consequent economic and social hardships. The difficulties can be expected to increase over the next 20-25 years, creating political problems of a most serious nature.

5.9. Little is being done now to overcome such problems. They are often viewed as being intractable and for this reason efforts of fisheries departments are often steered into development of new fisheries with the hope that they will lead to increases in production and a reduction in pressure on the traditional resources. As will be outlined in the next section, such diversions are rarely successful and the traditional inshore resources continue to be subject to destructive overfishing.

5.10. Evidence of the low priority given to the inshore fisheries includes:

- a. A lack of statistics on harvests and fishing effort and of studies to assess the effects of fishing on the stocks;
- b. a lack of knowledge on alternative approaches for conserving the resources;
- c. except for size limits on shellfish catches (often unenforced), occasional closed seasons and occasional harvest limits of quantities of shells taken, virtually no regulation of fishing;
- d. a lack of research staff dedicated to studying inshore fisheries problems; and,
- e. a lack of mechanisms for consultation between fisheries departments and village administrations and fishermen.

5.11. In short, research associated with the inshore fisheries is weak in most small island countries. This weakness is symptomatic of broader shortcomings in the organisation of fisheries activities in the countries and commonly includes failure to:

- a. Articulate management and development objectives with precision;
- b. anticipate information needs in advance with the result that information collecting activities are piecemeal, belated - reactionary rather than anticipatory;
- c. articulate information needs with precision; and,
- d. develop sufficient research capability.

5.12. In many countries, changes are urgently required. In view of the difficulty of the problems, however, it seems likely that in most areas changes can be made only after most thorough exploration of alternatives and the demonstration that change will increase benefits flowing to the communities. Much innovation and experimentation will be required. Major new policy initiatives may be required involving decisions, *inter alia*, regarding:

- a. Whether or not active control of the inshore fisheries is required and, if so, where, when and by what mechanisms;
- b. allocation of allowable harvests between traditional subsistence fishermen and artisanal fishermen, and, in some cases, industrial offshore fisheries where stocks (e.g. some tuna) are available both inshore and offshore;
- c. selection of markets (domestic or export); and,
- d. meeting non-fisheries needs of communities or individuals affected by stock declines or management programmes.

5.13. Information required to make such decisions is wide-ranging and voluminous. Most fisheries administrations in small island countries lack personnel, equipment, operating funds and knowledge to develop such information. The first step to meeting these problems is to articulate objectives for the management of the fisheries and then to define the information needs required to design action programmes to meet these objectives.

5.14. **Recommendation 1:** Regional organisations supporting fisheries activities in small island countries develop capabilities to assist small island countries in strategic planning for management and development of their inshore fisheries and for collection of information required to implement such management programmes, including information on:

- a. The state of the resources and the biological effects of fishing upon them, an especially difficult subject considering the multi-species, multi-gear nature of the fisheries;
- b. the state of the environment;
- c. benefits accruing from existing utilisation, including contributions to subsistence use;
- d. traditional use patterns and their adaptability;
- e. existing or potential users of the resource (subsistence, artisanal or semi-commercial; part-time, full-time or seasonal);
- f. alternative employment opportunities;
- g. markets and likely future market trends;
- h. factors affecting the entry to or exit from the fisheries;
- i. alternative forms of harvesting and processing technology; and,
- j. techniques for consultation and participatory management at the village level.

5.15. **Recommendation 2:** Donor agencies give a high priority to strengthening or creating regional arrangements for strategic planning and action programmes aimed at improving the management of inshore fisheries.

Nearshore Resources

5.16. In most small island countries, fisheries development activities have focused on new fisheries for resources that lie beyond the normal reach of traditional inshore fishermen using non-powered craft. These resources include deep-water snappers and groupers and pelagic fishes such as wahoo and inshore migrating tuna.

5.17. Development of small-scale commercial fisheries for such nearshore species has often involved substantial exploratory fishing and gear technology development. In general, because the fisheries are often the focus of government development efforts, technological and biological information associated with the nearshore fisheries is better than that available for the inshore fisheries. For most nearshore resources, the development phase is at or near its end. Concerns now focus on ensuring that the new fisheries do not deplete the resources or on creating economic or social circumstances to permit the fisheries to operate on a self-sustaining basis.

5.18. For successful development, substantial research efforts, conducted in the context of comprehensive policy development and programming will be required. Of particular importance are sociological issues. In the past research has tended to concentrate on biological and technological questions. Now, however, increasing problems are being encountered in achieving satisfactory blends of entrepreneurial activity with non-commercial aspects of village life. Particularly in the South Pacific, the development of viable small-scale fisheries on an economic basis that are at the same time consistent with traditional village life, remains an objective that is remarkably difficult to achieve. To provide solutions, research must extend beyond the usual biological and technological bounds and involve multidisciplinary approaches, particularly in the field of social science.¹

5.19. The types of issues to be explored for the nearshore fisheries are essentially similar to those listed in paragraph 5.13 dealing with the inshore fisheries.

5.20. **Recommendation 3: Regional organisations and donor agencies include nearshore resources in their support for research aimed at improving the management of small scale fisheries outlined in Recommendations 1 and 2 above (paras. 14 and 15).**

Oceanic Resources

5.21. As outlined earlier in the report, the oceanic resources provide the greatest potential for fisheries development in most small island regions (particularly the South Pacific and the Western Indian Ocean but in the Caribbean as well). The resources are now exploited mainly by the expeditionary fleets of developed countries.

5.22. Many island countries aspire to expand or establish local tuna industries, involving the establishment of local fishing fleets and/or onshore processing or transshipping. Others may wish merely to increase the benefits provided by distant-water fleets under terms of access agreements. Major investment decisions are required and technological requirements are at an advanced level. The information requirements to develop policies regarding these ocean fisheries involve a degree of sophistication and blend of skills not readily available in small island states.

5.23. Because oceanic pelagics move extensively across international boundaries, especially in respect of biological studies, there are strong needs for international cooperation in the collection of information. There is also a need to develop effective regional organisations to provide a focus for such cooperative activity.

5.24. In some places (particularly in the South Pacific), research such as described above is being conducted. However, substantial progress will have to be made in all three regions if the information required to assist countries to increase the flow of benefits from the offshore resources is to be made available.

5.25. **Recommendation 4: In regions where small island states benefit from the exploitation of oceanic resources, regional organisations foster cooperative research on such resources, particularly on technological**

and economic aspects of the fisheries. Information will be required on:

- a. Alternative technologies for harvest from the technical and economic points of view;
- b. alternative technologies for processing;
- c. sociological impact of the establishment of new industries;
- d. structures and operations of distant-water fleets;
- e. methodologies for assessing and collecting fees;
- f. mechanisms for surveillance and enforcement;
- g. market pathways and trends;
- h. knowledge of the abundance and migratory habits of the fish; and,
- i. knowledge of the effects of fishing on them, including interactions between fisheries (e.g., effects of large-scale offshore fishing on inshore small-scale fisheries).

5.26. Recommendation 5: Donor agencies support strengthening or creating regional arrangements for research on technological and economic aspects of fisheries for offshore oceanic resources in regions where small island countries have interests in developing fisheries for such resources.

Aquaculture

5.27. With a few notable exceptions, aquaculture has received relatively little attention in small island countries. However, the related field of reef enhancement (e.g., transplantation of trochus) is being developed in some areas and pearl culture is an important activity in parts of Polynesia.

5.28. Aquaculture could provide valuable alternative employment in rural communities. The culture of *Macrobrachium* is an example of such a potential and pearl culture might be tried in areas with suitable habitats. Reef ranching of shellfish appeals to villagers, blending well with existing harvesting practices.

5.29. Under these circumstances, expansion of research and technological development would seem warranted. To a considerable extent existing technologies could be used.

THE CHALLENGE

5.30. From the foregoing non-exhaustive lists of research requirements, it is apparent that the range of enquiry, the disciplines involved and the volume of research that will be required represent a quantum leap over the research now being conducted in most small island countries. Most countries have virtually no staff dedicated to the kind of work described. Development of cadres of personnel capable of such investigations at either national or regional levels represents the major challenge facing fisheries administrations that aspire to manage and develop their fisheries more effectively.

5.31. While emphasising the need for expansion in research it should be pointed out that, in many cases, such research need not be very sophisticated. Indeed, at the present stage of development, there is likely to be a large degree of trial and error involved, wherein accurate monitoring and a high degree of cooperation and participation of fishing communities will initially be required.

5.32. From the list of information requirements presented above, it is apparent that fields other than fisheries are involved (e.g., environmental and sociological concerns, alternative employment opportunities, etc.). It would seem that in future it will become increasingly important to develop fisheries planning and research within the

broader framework of rural economic or coastal zone development programmes. The recommendations made thus far in this chapter are consistent with this conclusion.

CONSTRAINTS

5.33. In many small island countries, the importance of fisheries is now recognised. In some, great efforts have been made to develop systems for the comprehensive planning and execution of fisheries management and development programmes.

5.34. In most, however, government systems are at an early stage of development and severe difficulties are being encountered in attempting to improve the performance of the fisheries. The first problem faced by many countries is to decide whether to attempt to develop local competence or whether to depend on outside agencies for the necessary expertise and advice. For a number of very small countries, there really is no choice; it is simply not within their financial or personnel capabilities to develop their own centres of fisheries competence.

5.35. Even for larger countries, the levels of skills of fisheries staff is usually not considered adequate and outside assistance and advice is frequently sought. These circumstances create an unusually high degree of interest in and dependence of small island countries on regional fisheries organisations. The success of future programmes of fisheries management in regions composed mainly of small island countries will depend to a considerable extent on the effectiveness of regional organisations in structuring themselves to meet the needs of the countries they serve.

THE ROLE OF REGIONAL ORGANISATIONS

5.36. Regional organisations can play a number of important roles in strengthening the capabilities of the countries to manage and develop their fisheries. These include:

- a. Training national experts;
- b. providing a source of technical experts who can assist individual countries; and,
- c. conducting research of general utility to countries of the region.

5.37. The functions of regional organisations fall more or less into three categories:

- a. Training (particularly at the academic level);
- b. management of migratory oceanic resources (shared stocks); and,
- c. technical support for national fisheries development.

5.38. Two or more of these functions may be carried out by the same organisation or they may be carried out by separate organisations.

Training

5.39. In the South Pacific and the Caribbean, academic institutions are relatively well developed and provide the basic nucleus for training of personnel entering government service. In the South Pacific, regional organisations (e.g. the South Pacific Commission and the Forum Fisheries Agency) provide frequent training opportunities in specialist subjects. There are a number of cooperative marine-oriented programmes in the Caribbean and measures are planned to strengthen cooperation through existing regional institutions, particularly CARICOM.

5.40. The ethnic and political diversity of the small island countries of the Western Indian Ocean have militated against the development of centralised regional training in fisheries. Nearly all personnel entering government fisheries services have therefore been trained overseas. To help overcome this situation the small

FAO/UNDP Southwest Indian Ocean Fisheries Programme provides periodic short courses for fisheries personnel in island fisheries administrations.

5.41. Despite the availability and diversity of training, in all three regions, its impact has been uneven. In general, island fisheries research capabilities remain woefully weak. There would seem to be an important need for island governments to develop more precise objectives in respect of the levels and mixes of skills required for research and to work with regional organisations to ensure that the training that is available is appropriate and adequate.

5.42. **Recommendation 6:** In light of the developments proposed in Recommendations 1-5, regional organisations and donor agencies provide assistance to small island countries in developing objectives and plans for research staff development including definition of the number of personnel, the particular skills and levels of proficiency required.

Management of Oceanic Resources

5.43. The conclusion of the 1982 Law of the Sea Convention, permitting the extensions of fisheries jurisdictions to 200 miles brought vast areas of the world's oceans under the management control of small island countries. The principal resources in these waters are pelagic fishes, particularly tuna. It is these resources that frequently provide small island countries with their greatest opportunities to increase the benefits they derive from the sea. At present only a few island countries are the principal beneficiaries of the tuna resources off their coasts; tuna are subject to intense competition on a global scale and developed countries are the principal harvesters of the resource.

5.44. Because of the importance of the tuna fisheries, they have been the subject of intensive international efforts for control and management around the world. Traditionally, arrangements have been sought wherein all harvesting nations cooperate to share statistics, to arrange research to assess the state of the stocks and to develop cooperative arrangements for regulation of the fisheries on a mutually agreeable basis. Organisations formed to carry out such functions include both coastal states and distant-water fishing states. Organisations of this type were formed for the tuna fisheries of the eastern tropical Pacific (the Inter-American Tropical Tuna Commission) and in the Atlantic (the International Commission for the Conservation of the Atlantic Tunas). The latter organisation covers the tuna of the Caribbean area and small Island states of that region are eligible for membership. At present, there is virtually no participation by the small island countries in the Commission.

5.45. In the South Pacific, the traditional broadly based model adopted in the eastern tropical Pacific and the Atlantic was rejected by the coastal states who instead formed the South Pacific Forum Fisheries Agency (without the participation of distant-water fishing states), to harmonise coastal state management policies and negotiations with distant-water fishing nations regarding access to the resource. The Agency has been the active focus of economic and administrative research regarding the management and development of industrial tuna fisheries. However, lack of a broadly-based tuna organisation has been an impediment to the collection of statistics and the assessment of the state of the stocks. Nevertheless, the South Pacific Commission, an agency formed to foster educational and cultural exchanges among the South Pacific islands, has developed a major tuna research programme that serves as a focus for the assembly of catch statistics and studies on the migrations and interactions of the stocks. The Programme is striving to meet the needs for information without the formal mandate of a cooperative international tuna management research and management body.

5.46. In the Indian Ocean, under the auspices of the United Nations Food and Agriculture Organization, attempts are being made to negotiate a convention to establish a broadly based organisation for the region similar to ICCAT in the Atlantic. At the same time, however, some coastal states of the region are exploring the possibility of forming a separate and parallel coastal state agency that could have functions similar to those of FFA in the South Pacific.

5.47. In the Caribbean, tuna are less important and the regional tuna organisation responsible for research covers a vast area, making it difficult to devote attention to purely Caribbean interests. More specific initiatives for the Caribbean area may be in order. In this light it would seem to be appropriate for the small island

countries of the Caribbean to participate on a more active basis in ICCAT's work and to press for more active consideration within ICCAT of local Caribbean issues.²

5.48. Tuna research organisations tend to be staffed with experienced expatriate experts. Their work is generally of very high quality and such organisations are often world leaders in their fields. This serves their member countries well, but such concentration of expertise tends to create a gap between the technical capacities of the agency staffs and of their clients, including the small island countries. Too often, small island countries tend to delegate their responsibilities to the agency staffs themselves or to representatives of larger countries. Creating effective linkages between fisheries administrations in small island countries and in international agencies remains an important challenge.

5.49. Such linkages are more in the field of diplomacy and management than in research. Recommendation 5 above addresses the question of strengthening cooperative work on the oceanic pelagic resources.

Technical Support for National Fisheries Development

5.50. The South Pacific is abundantly served with international agencies offering support for national fisheries development. As outlined earlier, most small-scale fisheries development is associated with fisheries for nearshore resources (e.g., snappers and groupers and inshore migrating tuna). Both the Forum Fisheries Agency and the South Pacific Commission provide advisory services. The latter organisation has been particularly active in conducting exploratory fishing and in demonstrating appropriate fishing technologies that have resulted in the development of technically successful fisheries throughout the South Pacific. Numerous bilateral programmes of assistance are also available.

5.51. In the Caribbean, the Organisation of Eastern Caribbean States (OECS) has a Fisheries Unit which assists countries in data collection on their fisheries and plans are afoot to strengthen the CARICOM agency's support in this field. FAO/UNDP operates a small programme in the Western Indian Ocean serving the same function. The project has recently been concentrating on multidisciplinary approaches in its advisory services wherein biological, sociological and economic aspects of national development programmes are examined together.

5.52. In all three regions, existing initiatives or those that are under consideration provide valuable and effective support for fisheries administrations in small island countries. The recommendations made earlier in this chapter propose strengthening the work of such organisations.

ASSESSMENT

5.53. Fisheries plays an unusually important role in the economies and cultural life of most small island countries. Fisheries research in small island countries of the South Pacific, the Caribbean and the Western Indian Ocean is generally in an early stage of development. With small human populations and small economies, it is extremely difficult for the countries to develop research capabilities of sufficient standard or scale to meet information needs required for effective management and development of their important fisheries. The small staffs that are employed often do not possess appropriate skills and in many instances have such a range of duties that they cannot perform effectively as research workers.

5.54. Except in the Caribbean, the isolation of the countries makes it hard to develop cooperative arrangements for research between countries; effective communication and exchange of ideas and information is particularly difficult.

5.55. In all three regions, international and bilateral assistance agencies are actively providing support for fisheries research at all levels. To date, however, these relatively extensive efforts have not led to a substantial improvement in the research performance of individual countries.

5.56. Past assistance programmes in the research field have often concentrated on immediately visible and identifiable capital construction and equipment acquisitions. Direct support for research projects by aid agencies has been difficult because of lack of in-house capacity in the agencies to judge the merits of research projects

proposed. As expressed in recommendations presented earlier in this chapter, there is an important need to develop better mechanisms for identifying and prioritising assistance requirements for research projects.

5.57. In general there would appear to be major shortcomings in the organisation of fisheries activities in most countries. Government systems for the assessment of fisheries potentials and problems, selection of programmes to capitalise on opportunities or to overcome problems and the execution and monitoring of such programmes are rarely well developed. Lack of such systems creates an unproductive environment for the conduct of research in support of fisheries management and development.

5.58. Prospects for improvement seem dim unless governments attempt to provide more structured approaches to their fisheries programmes. Some progress might be made if research needs were examined on a regional basis. Thus, island countries working through their regional organisations might specifically attempt to develop long term plans for research on a regional basis, identifying the research that needs to be done and making decisions regarding the division of research responsibilities between regional organisations and individual countries. Such explorations could provide a greatly sharpened focus for the planning of research and for staff development, both within individual countries and within the regional organisations.

5.59. A useful approach would be to examine the benefits of providing regional support for work in one country that would have broad applicability throughout the region.

5.60. **Recommendation 7: Regional organisations and donor agencies foster strategic planning of research on a regional basis, including consideration of division of labour between regional organisations and countries to make the best use of scarce human and financial resources.**

NOTES

1. The comments in this paragraph should not be considered to imply that past biological research has been adequate. Indeed, as outlined in the preceding two chapters, past research in this field has suffered from lack of focus, reactionary rather than anticipatory approaches, etc.
2. ICCAT supports a Billfish Data Collection Program in the western Atlantic (including the Caribbean). Its objective is to collect size data and conduct age studies on billfish throughout the western region.